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Edited by
LEWIS STEPHEN PILCHER, M.D., LL.D.
of New York

With the Collaboration of
J. WILLIAM WHITE, M.D., LL.D. of Philadelphia
SIR WILLIAM MACEWEN, M.D. of Glasgow
SIR W. WATSON CHEYNE, C.B., F.R.S. of London

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ANNALS *of* SURGERY

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ACIDOSIS IN SURGERY

A REVIEW OF 138 CONSECUTIVE MAJOR OPERATIVE CASES, IN WHICH THE DOMINATING INFLUENCE OF ACIDOSIS WAS CONSIDERED

BY GARNETT W. QUILLIAN, M.D.

OF ATLANTA, GA

VISITING GYNÆCOLOGIST TO THE GRADY (CITY) HOSPITAL

MORE than a year ago (October, 1914) in preparing a diabetic patient with gangrene of the foot for high amputation, the dominating influence of acidosis was appreciated, though not understanding perfectly its phenomena. At this time it was demonstrated that when diacetic acid was present in the urine of the patient, the gangrene of the foot became more progressive, but when, by absolute rest, and the liberal use of soda bicarbonate and dextrose, the urine became free of diacetic acid, the patient's condition, both local and general, considerably improved. The limb was amputated at the junction of lower and middle thirds of the femur and the patient recovered from the operation, the incision healing with comparatively little delay. A routine preliminary examination for diacetic acid has since been made in every operative case, and since June 1, 1915, whether an acidosis was present or not, soda bicarbonate and dextrose have been given to every patient as a routine preliminary preparation for operation, the same being used liberally in post-operative care as well.

The article of Crile, "Influence of Acidosis in Surgery" (ANNALS OF SURGERY, September, 1915), prompts me to report 138 consecutive major operative cases in which the acidosis factor was considered. In his paper Crile points out that operative trauma and inhalation anæsthesia always produce acid by-products, which affect primarily the brain, the adrenals, and the liver, and thereby encourage the production of an acidosis with its resulting shock. The fact that in this series of cases there was no mortality, and in only five appreciable shock, leads me to the belief that the preliminary treatment and post-operative care played no unimportant part. A large percentage of these operations was performed on women during a recent service at Grady Hospital and since June 1, 1915. These include:

Appendectomies (acute appendicitis) 27
Appendectomies (chronic appendicitis, and incidental routine while the abdomen was open) 73

Complete hysterectomies (carcinoma cervix)	3
Subtotal hysterectomies (fibroid uterus)	9
Nephropexy	4
Repair uterus (rupture)	1
Cæsarean section (abdominal)	5
Herniotomy (umbilical, 3; inguinal, 1)	4
Resection omentum (post-operative adhesions, 4; obstruction of small intestine, 2)	6
Resection ovary (cystic degeneration)	45
Round ligament suspension (Gilliam)	24
Round ligament suspension (Murphy)	14
Salpingo-oöphorectomies (salpingitis)	29
Resection ileum (sarcoma)	1
Exploration (inoperable carcinoma small intestine)	2
Myomectomies (intramural fibroid)	4
Cholecystostomy (cholecystitis)	2
Percy cautery (inoperable carcinoma cervix)	2
Abdominal cavity filled with normal saline solution (tubercular peritonitis)	2

In one of the Percy cautery operations, the second part was performed by Dr. L. S. Hardin. In no case was an ovary or tube sacrificed when it was at all possible to retain it. In none of the above cases was Crile's anoci-association practice employed, but in every case acidosis was avoided and the operation was performed as rapidly as was consistent with careful technic, and with the least possible shock from hemorrhage and manipulation. In fifteen of this series the transverse abdominal incision was employed with most gratifying results.

The following preliminary and post-operative routine was followed in every case except a few emergency cases when glucose and soda bicarbonate aa℥ss was given in a retention enema a short time preceding operation:

Preliminary.—Soda bicarbonate ℥ss in ½ glass water t. i. d. ½ hour before meals, for two days preceding operation.

Soda bicarbonate and glucose aa℥ss with water q. s. ad ℥viii as a retention enema, b. i. d. for two days preceding operation.

Liquid diet, and large quantities of water for 48 hours preceding operation, but no buttermilk nor egg albumens for 24 hours preceding operation. (This to prevent accumulation of gas.)

Castor oil ℥ss the morning preceding the day of operation.

S. S. enemas the night before and morning of operation.

Bichloride of mercury douches 1–10,000, if vaginal work is to be done, the night before and morning of operation.

Strontium bromide Gr. xxx the night preceding operation (to insure a good night's rest).

Morphia Gr. ⅛ with scopolamine Gr. $^1/_{100}$ one hour preceding gas and ether anæsthetic.

Post-Operative.—Adrenalin chl. m xv. q. 6. h. for three doses.

Pituitrin ⅓ to ½ c.c. six hours after operation, to be repeated in one hour. (This anticipates and combats secondary shock and acting also as a diuretic, in

many cases makes catheterization unnecessary, thereby avoiding possible unpleasant cystitis.)

Saline and black coffee aa℥iv to be retained if operation is prolonged or necessary to combat shock. (May be given q. 6. h. for several days.)

Codeine sulphate Gr. i p. r. n. for pain. (Morphine is rarely used.)

Strontium bromide Gr. xx p. r. n. for sleep.

Soda bicarbonate ℥ss in ½ glass of water ½ hour a. c. for several days after operation.

Water and liquid diet when nausea ceases for three days. After which a light diet is allowed.

An eliminant is given on the third day following operation.

Of the tabulated series, there are several cases of especial individual interest:

CASE 61.—This patient entered the hospital on July 15, 1915, with a hæmoglobin of only 18 per cent. Various tonics failed to raise the percentage, so on August 21 transfusion was done, her husband being the donor. The hæmoglobin was raised to 50 per cent. immediately, and on September 2 the percentage had increased to 55. On this date operation was performed, and on September 27 patient was dismissed from the hospital with a hæmoglobin of 70 per cent., having had an uneventful recovery.

CASE 58.—Though comparatively a simple operation, this patient left the operating table in apparently perfect condition, but four hours later suddenly and unexpectedly suffered an almost complete collapse—unconscious, pulse imperceptible, respiration very difficult. The foot of the bed was elevated, and pituitrin 1 c.c. was given. In about one-half hour the patient recovered consciousness, and seemed to be in good condition again. She remained normal for three hours, when suddenly and without warning she suffered a second collapse, not quite so severe, however, as the first. The same treatment was given with oxygen added, and after a short time she again became normal. In six hours, the patient again suffered a similar collapse, but not quite so severe as the one preceding, again recovered, and during the succeeding 72 hours suffered at varying intervals six distinct similar attacks, each one being slightly less severe than the one preceding. The same emergency treatment was given, the patient having a long eventful convalescence, developing middle ear and other complications. The diagnosis which was suggested, and which was concurred in by several of the most prominent surgeons in Atlanta, was that of embolism.

CASES 22, 31 and 63.—In each of these cases there were extensive adhesions of the intestines and multiple raw surfaces with profuse hemorrhage difficult to control. The dry coagulin powder was sprinkled over the bleeding points in two cases, and the solution given intravenously in the third seemed to arrest the trouble-

some hemorrhage immediately, so that packing with gauze was unnecessary.

CASE 99.—This patient in addition to being sixty-four years of age, and having intestinal obstruction from omental adhesions from an old umbilical hernia, had diabetes. Diacetic acid was kept eliminated from the urine, and while a small opening in the transverse incision drained for several weeks, she had an uneventful recovery.

CASE 89.—This patient had a ruptured, gangrenous appendix, and on the seventh day developed a fecal fistula. This, however, in two weeks closed spontaneously, and after the second operation, closing the wound, recovery was uneventful.

CASE 52.—This patient, in addition to a twelve-pound fibroid tumor of the uterus, had an umbilical hernia. A T-incision was made extending transversely six inches, and perpendicularly from the symphysis pubis to the umbilicus; delivery was easy, closure simple, and recovery prompt.

CASE 88.—This patient punctured her own uterus with a wire which was run through a catheter, and which had been "loaned" to her by a "friend" with which to produce an abortion. While straining at stool, she forced a loop of small intestine into the uterine canal through the tear. At the time of operation some six hours later she was in extreme shock. The intestine was replaced, the wound in the uterus closed, the abdomen drained, and the incomplete abortion completed. With the exception of a mild peritonitis, recovery was prompt.

CASE 57.—This patient was a negro child fourteen years of age with a contracted pelvis (full term), who was admitted to hospital with paresis of the tongue and left lower limb. Section was successfuly performed, and the normal use of tongue and limbs returned six hours after reacting from the anæsthetic.

CASE 137.—In this case twins were delivered.

Very few of the 138 cases suffered nausea of any consequence; in only five was there sufficient post-operative shock to cause anxiety, four due to prolonged operation, who responded to stimulation, and one due to flatulency, who responded to peristaltin.

The conclusions which are naturally deducted from a careful observation of this series of cases are:

(*a*) Acidosis has a dominating influence in surgery.

(*b*) By preliminary and post-operative treatment acidosis may be largely eliminated, which is just as important as the operation.

(*c*) Post-operative discomfort and nausea is greatly diminished by liberal preliminary use of soda bicarbonate.

(*d*) Surgical shock may be avoided by preventing acidosis and by rapid, careful technic in operative procedure.

PULSATING EXOPHTHALMOS*

WITH REPORT OF A CASE CURED BY LIGATION OF COMMON CAROTID ARTERY

By Goodrich B. Rhodes, M.D.
of Cincinnati, Ohio

The subject of pulsating exophthalmos has been studied by many writers, notably Sattler, Eysen, and de Schweinitz and Holloway, whose monographs cover the reported cases to 1908. Sattler has collected 106 cases, Eysen 167, and de Schweinitz and Holloway 69, a total of 342. A study of these cases, however, reveals the fact that a number of cases are duplicated in Eysen's and de Schweinitz and Holloway's lists, reducing the actual number to 256. Since de Schweinitz and Holloway's study there have appeared in the literature 52 cases of pulsating exophthalmos. These I have collected and made, together with my own case, the basis of this study.

The symptom-complex of pulsating exophthalmos has been shown by operation and autopsy to be caused by one or more of the following lesions: aneurism of the ophthalmic artery inside or outside of the skull, pulsating orbital tumors, aneurismal dilatation of the internal carotid artery in the cavernous sinus, thrombosis of the cavernous sinus and ophthalmic vein, arteriovenous aneurism of the orbit, pressure on the sinus by an external growth, and rupture of the internal carotid into the cavernous sinus. This paper will concern itself solely with those cases probably due to rupture of the internal carotid into the cavernous sinus, whether caused by trauma or occurring spontaneously. I say probably, for the diagnosis is not always certain, as Wilder found no lesion of the carotid in six clinically characteristic cases which came to autopsy. There were no postmortems made in my series.

In this series of 53 cases 37 were found to be traumatic in origin, 9 occurred spontaneously, while in 7 the cause was not given.

The average age of the patients was thirty-six. The youngest was fifteen, and the oldest, a spontaneous case, was eighty-four.

There were 31 males and 10 females, the sex not being mentioned in the other 12 cases.

In the traumatic cases the time elapsing from the receipt of injury to the appearance of the first symptom, bruit, clings remarkably closely

* Read before the Southern Surgical and Gynæcological Association, December 13, 1915.

to an average of 21 days. To this fairly constant latent period certain cases present a marked exception, six cases occurring immediately upon receipt of the injury, while the cases of Lystad, Orloff and Hildebrand show intervals of two years, six months, and four months respectively.

The left eye was affected in 15 cases, and the right in 23. A bilateral involvement occurred in 4 cases, 2 of them being spontaneous in origin, 1 due to trauma and the fourth having no cause mentioned.

Upon the classic tripod of exophthalmos, orbital pulsation and a bruit audible both to patient and examiner, is built up a superstructure of phenomena which can be divided into those due to the aneurism itself, and those caused by nerve lesions either traumatic in origin or resulting from prolonged circulatory disturbances set in motion by the reversal of circulation. The exophthalmos, bruit and pulsation are obviously due to the aneurism and are among the first to appear, and of these the first and most constant in its appearance is the bruit. Exophthalmos occurred at later periods, varying from a few days to a month after the bruit. Pulsation is a still later symptom, appearing within a few days after exophthalmos has been noticed. The subjective character of the bruit is variously described by the patients. We read of noises like escaping steam, rattle of machinery, chirping of birds, and other comparisons expressing sounds entirely unlike. Objectively the bruit is the typical arteriovenous aneurismal bruit, with systolic accentuation, usually heard with greatest intensity over the orbital cavity or the temporal area, and along the course of the vessels in the neck. In some cases it was of interest to note that the only place where the bruit could be heard was along the lateral sinus.

Certain nerve lesions are commonly noticed which can be explained by a study of the anatomy of the region. The most serious lesion is atrophy of the optic nerve, either due to immediate laceration from basal fracture, pressure or slow development from continued circulatory disturbance. Paralysis of the motor mechanism of the eyeball is in some cases due to extreme exophthalmos, in which cases the globe is immovable, and in others due to lacerations or pressure upon individual nerves, among which the abducens is most common. This nerve was paralyzed in 9 cases, among which one was spontaneous, namely that of Hird and Haslam. It has been claimed by some authors that paralysis of the abducens is characteristic of the traumatic variety exclusively, and is indicative of basal fracture, but this individual presented a slowly developing external rectus paralysis beginning six days after admission to the hospital with spontaneous pulsating exophthalmos.

Loss of pupillary reflex with persistent dilatation of the pupil

occurs in many of the cases, both spontaneous and traumatic, and is due to laceration of the carotid plexus of the sympathetic. Injury to the superior petrosal nerve carrying facial nerve fibres is said by some to be responsible for the absence of tear secretion, but was observed only in the case of Lystad.

Various minor symptoms are encountered with great frequency. Among these are diplopia, hemorrhages or œdema of the retina, tortuosity and dilatation of the retinal veins. Almost all cases show an increase in ocular tension, but only two cases developed an absolute glaucoma.

Facial paralysis is a rare symptom, occurring most often in the traumatic type of the disease, but like abducens paralysis can no longer be said to be confined purely to that variety.

Any study of the forms and effects of treatment must necessarily be complicated by many factors. It is not to be expected that gross nerve injuries occurring primarily will be cured by any method at our command, nor will cases coming late to operation with complete degeneration of the optic nerves be restored to vision by a cure of the aneurism. By a cure we understand, then, those cases in which the exophthalmos, pulsation, bruit, and chemosis have been permanently stopped. In addition we find that several methods of treatment have been frequently employed in the same case. These have been classified as a failure for the first form of treatment employed, but if a cure resulted after other methods were used in addition, it was recorded as a cure of the combined treatment. A carotid ligation in itself may be a failure, but may produce enough change to enable a subsequent ligation of the ophthalmic vein to perfect the cure.

The methods of treatment employed in these 53 cases embrace practically all the known procedures which have been advanced, with the exception of electropuncture:

1. Ligation of common carotid alone. Fifteen cures, 3 improved, and 4 failures. One of these failures, reported by Buchtel, resulted in death, from what cause is not mentioned. Another one, that of Barbieri, died from secondary hemorrhage. Thus we have a mortality of 9.1 per cent. for this method. Previous estimates of the mortality are given by Eysen, 6.2 per cent., Orlow, 8.3 per cent. and de Schweinitz and Holloway, 11.7 per cent. Averaging these percentages we have a general mortality of all reported cases of 7.8 per cent. for carotid ligation. It must be remembered, however, that a considerable number of these patients died from secondary hemorrhage, as a result of operation in the pre-aseptic period, so we are faced by the fact that our

mortality at the present day is greater by far than the mortality from the first 113 cases reported, in which there was only 1.9 per cent. The mortality from carotid ligation should be merely the mortality of the disease for which the ligation is done, therefore a percentage of 7.8 per cent. would seem to be entirely too high. The mortality of carotid ligation for all causes, in 172 cases as compiled by Siegrist from 1881 to 1897, is 20.5 per cent.

In a certain number of instances the bruit and pulsation are stopped when the common carotid of the same side is compressed. Others are unaffected. Common carotid ligation effected a cure in 10 cases in which digital compression over the carotid absolutely stopped the bruit and pulsation. In 1 such case carotid ligation failed to cure. On the other hand, in 3 cases in which pressure failed to check pulsation and bruit, failure resulted from carotid ligation alone. May it not be possible to derive from this a prognosis of the probable result of operation by ligation of the carotid? To make a more complete study of this point I have reviewed the 106 cases of Sattler, and I find 33 of these in which observation of the effect of pressure on the bruit is made. The results are as follows:

Cures when digital pressure completely stopped the bruit	19
Failures when digital pressure did not completely stop the bruit	6
No cure when digital pressure completely stopped bruit	4
Cures when digital pressure failed to completely stop the bruit	4

By combining these figures deduced from Sattler's statistics with mine it will be noticed that 38 out of 47 cases, or roughly 80 per cent., will support a prognosis which may be expressed as follows: Pulsating exophthalmos in which digital pressure on the common carotid of the same side stops the bruit completely will probably be cured by ligation of that common carotid alone. Or, this might better be expressed, that pulsating exophthalmos in which digital pressure on the common carotid fails completely to stop the bruit will probably not be cured by simple ligation of the common carotid. Emphasis is laid on the bruit because it is the most persistent symptom and yet the one which is detected with the greatest delicacy by the patient.

2. In 1897 Schimanowsky first ligated the superior ophthalmic vein, after unsuccessful ligation of the common carotid. This orbital operation, commonly known as Sattler's operation, was performed as a primary procedure in 3 cases in this series with 2 successes and 1 failure. One of the successful cases was operated on by the temporary resection of the outer wall of the orbit.

3. Continuous compression of the common carotid was resorted to in 8 cases. Only 1 of these, that of Claiborne, was cured, after wearing a constant pressure bandage for eighteen months.

4. Injections of gelatinized serum after the method of Lancereaux and Paulesco were carried out in 6 cases. Two were cured, 2 improved, and 2 received no benefit. The treatment consists in the intramuscular injection of 2 per cent. solution of gelatin in serum. Five per cent. or more is very painful and causes a rise of temperature. Less than 2 per cent. is without effect.

5. In one case Cunningham produced a cure by the use of Neff's gradually contracting clamp (catgut and rubber band) applied to the common carotid.

6. Ligation of internal carotid. This method is the operation most highly recommended by various writers. Of the 4 cases so treated 1 was cured and 3 were improved. No failures resulted.

7. Ligation common carotid combined with ligation of superior ophthalmic vein, angular vein, inferior ophthalmic vein or any other orbital vein which is found dilated or pulsating. Three cases were cured and one failed by this method.

8. Weinkauff reports one spontaneous cure in an eighty-four-year-old woman, apparently a case produced spontaneously.

9. Ligation of common carotid and superior thyroid. Two cases were cured. No failures.

10. One ligation of the external carotid was employed with a successful result.

11. Ligation of the common carotid followed by ligation of the internal carotid resulted in improvement in one case.

12. Ligation of both the external and internal carotid together with the internal jugular vein in one case resulted in failure. This same case subsequently treated by the orbital operation was greatly improved.

13. Zeller has proposed the following operation: Ligation of the internal carotid close to the skull in the neck combined with ligation of the artery just proximal to the origin of the ophthalmic artery. Cadaver experiments showed him that it is possible only in exceptional cases to see the origin of the ophthalmic artery and to put a ligature proximal to it around the internal carotid without pulling on the latter vessel. In the single case in which this method was tried the ligature sawed through the artery before it was tied. The patient died of hemorrhage.

14. Enucleation of the orbit was resorted to in 2 cases in which absolute glaucoma developed.

The total number of cures by all methods is 26. Nine were improved and 10 resulted in complete failure.

It is hard to draw any accurate conclusions as to the best method of treatment from so small a collection of cases, but the total number of reported cases is so small that we must be guided more by a study of the individual ones than by statistical deductions in arriving at any conclusion. Ligation of the common carotid is undoubtedly the classical operation, first performed by Travers in 1803, and is probably the safest method. But even in this procedure deaths have occurred, and in this series cerebral complications occurred in two cases, paralysis of forearm and hand and difficulty of speech in the one instance, and in the other aphasia and facial paralysis occurred one month after ligation, so it is only fair to assume that it was due to extension of the clot into some small branches of the middle cerebral. The orbital operation, while yielding good results, exposes the patient to great danger from hemorrhage in some cases. No method has proved free from danger. Even the gelatinized serum injections of Lancereaux-Paulesco have resulted in apoplectic attacks probably due to embolism or thrombosis.

In the case of immediate failure by any one method, what shall be done? Cures have resulted from various ligations after long periods, but shall we await that result, or shall a second operation be made within a few days or weeks? This would seem to depend entirely upon the condition found by the oculist, who should work in conjunction with the surgeon. If the optic nerve is completely atrophied it might be well to await the result of the first ligation, but if the nerve is not entirely gone the case should be kept under constant supervision by an oculist, and a second operation performed when in his opinion permanent damage to the nerve is seen to be threatening. The second operation which gives the best results would appear to be the orbital ligation. Ligation of the other common carotid was only practised in one case, resulting in failure, and would not seem to possess any more advantages, and to present greater dangers than the orbital operation.

AUTHOR'S CASE.—W. W., male, aged twenty-seven, was struck October 29, 1914, on right side of head by a thug. He was knocked over to the left side and struck the left side of his head against a pile of granite blocks. No visible wound. Unconscious for a short period, but was able to walk to his home, suffering intense pain and vomiting frequently. Within 24 hours he noticed a throbbing noise in his head. This, with headache, steadily increased and

FIG. 1.—Condition in December, 1914, before ligation of left common carotid artery.

FIG. 2.—Condition five months after ligation of left common carotid artery: aneurism cured; no exophthalmos or pulsation. Clot in orbital veins of right eye developed April 10, 1915.

persisted, followed by prominence of the left eye with intense venous congestion of the conjunctiva of both eyes. Vision of left eye blurred. December applied for treatment to Dr. Robert Sattler, to whom I am indebted for the privilege of operating upon this case. Exophthalmos of fully 2 cm. of left eye (Fig. 1). Orbital pulsation. Bruit heard most distinctly over the eye and adjacent temporal region. Patient complains of constant rhythmic loud noise in the head which allows him little sleep. Pronounced chemosis present.

Ophthalmic examination by Dr. Sattler showed marked venous stasis with enormous dilatation and tortuosity of the branches of the central retinal vein and general œdema of the retina. Orbital venous stasis of right eye. Compression of the left common carotid silences both the subjective and objective bruit and reduces the orbital tension. Exophthalmos is lessened, but does not entirely disappear. Pulsation ceases immediately.

Operation (January 22, 1915).—Ligation of common carotid with two silk ligatures. No symptoms were noticed when ligature was tied. The patient had immediate and permanent relief from the bruit and pulsation, while the exophthalmos receded very gradually, being still noticeable four months later. Vision returned to normal and remained so. April 10, 1915, three months after operation, he developed an intense chemosis of the lids of the right eye, but no exophthalmos nor pulsation (Fig. 2). This subsided after several weeks, aided by a plastic operation performed by Dr. Sattler, and was thought to be due to the extension of the clot into the orbital veins. He is now perfectly cured.

CASES FROM THE LITERATURE

I. CUNNINGHAM: White man, aged thirty-nine, no previous disease except dysentery (Philippines). Four years ago in a fight was struck on left cheek. Spat blood and felt sick. Two days later roaring in head began and gradually grew worse. Could not sleep lying down and spent nights in chair. Two months later sudden pain in right temple, and eye protruded to a marked degree. Diplopia and dilatation of superficial veins over eye and temple. While returning from work he became temporarily unconscious. Taken to hospital.

Decided to try Neff's clamp (*Jour. Amer. Med. Assoc.*, August 26, 1911, p. 700), catgut, and rubber band. Applied so that faint pulsation was noticed distal to clamp. Visible pulsation disappeared in orbit. Bruit lessened. Four days later both had entirely disappeared. Left hospital on tenth day.

September 30: Exophthalmos lessened. No bruit or pulsation, or roaring in head.

October 9: Clamp removed. Found to have cut its way through artery. Dysphagia by pressure on trachea. Improved spring pressure clamp described, to lie parallel to vessel, and not press on surrounding tissues.

II. BEAUVOIS, A.: (1) Woman, aged forty-one, fracture of base of skull from falling down stairs. Month later, right exophthalmos; no pain. Systolic

murmur. Later, right-sided abducens paralysis, diminished vision. Ocular and carotid compression without result. Common carotid ligated three months after accident. Murmur ceased, slight aphasia and left lid paresis. Exophthalmos persisted, but less. Gradual loss of vision. Ten days later murmur reappeared but could be stopped by compression of left carotid. Injected 5 c.c. of 1 per cent. gelatinized serum into thigh every other day. After three injections (Lancereaux-Paulesco), injection increased to 20 c.c., then 50 c.c., at last to 100 c.c. Exophthalmos disappeared, but paralysis of both abducens and slight dilatation of pupil persisted. Three months after beginning treatment a local cure.

III. (2) Woman, aged fifty-three, received severe blow beneath right eye with the handle of a pump, ten years before. First seen December, 1905. August, 1905, intense pain in the right side of head. At end of December, 1905, diplopia, exophthalmos, conjunctival reddening, systolic murmur. Fundus slightly congested. Vision: Right, 0.4, left, 0.6; paralysis of right abducens. Visual field slightly diminished. Injection in thigh 2½ per cent. gelatin every five days. After 22 injections exophthalmos reduced one-half, with normal motion and complete disappearance of diplopia.

IV. ZELLER: Case report of one operation—patient died of hemorrhage caused by ligature sawing through the artery before it was tied. Zeller's procedure: Ligation of internal carotid as near as possible to the skull in the neck and also the ligation of the artery just proximal to the origin of the ophthalmic artery. Cadaver experiments showed him that it is possible only in exceptional cases to see the origin of the ophthalmic artery and to put a ligature proximal to it without pulling on the carotid. The possibility of a clot caused by the ligature obliterating the ophthalmic artery must be considered.

No danger to the eye is to be expected, collateral circulation is very free. No danger to brain.

V. BECKER: Soldier, wounded by explosion of his gun. Four wounds on the right side of face, two on nose, one at corner of mouth, and another in right eye. Ten days later, left eye protruded, increasing steadily in next few days. Retina showed hemorrhages and the ocular movements became more and more limited until entirely lost. On eighteenth day pulsation appeared. Compression of carotid caused diminution of pulsation. X-ray showed fragment of bone 2×1.5 cm. in the neighborhood of cella turcica and cavernous sinus. Internal carotid ligated one and one-half months after accident. Relief for four weeks, then return of former symptoms, but in eight weeks great improvement. After three months further improvement. Lateral movements of eyeball normal. Vision with a plus $4 = 5/15$.

VI. JACQUES: Man, aged twenty-five, injured in motor-cycle accident by falling against the wheel, striking on right side of head. Base fracture. Three weeks later pulsating exophthalmos. Intense epistaxis nine times in six weeks from right nostril, occurring after any strong effort. Ligature of right common carotid. Three days later improvement, but later return of all symptoms. Still later operative exposure of the inner portion of orbit. A polyp was found in the sphenoidal sinus which communicated with the cavernous sinus. Sphenoidal sinus packed with iodoform gauze which was removed on the sixth day without hemorrhage.

VII. POOLEY: Negro, aged thirty, struck on back of head with a blackjack. Three scalp wounds, one on parietal bone near junction with occipital, one

further forward, and another on the temple. Unconscious. Distressing noise in head on recovering consciousness. Two days later all symptoms of arteriovenous aneurism except pulsation. Exophthalmos, injected conjunctiva and lids, blowing murmurs heard over eye and a continuous whirring rumbling sound. Eye could be pushed back. Carotid compression diminished but did not stop bruit. No change in fundus and vision unimpaired. Treated for a few days by pressure bandage and carotid compression. Later, ptosis, exophthalmos, enormous dilatation of conjunctival vessels and lids, pulsation, especially at inner canthus, papillitis with enormous dilatation of retinal vessels. One vein in the lower temporal region seemed to be obstructed; above and below the obstructed part was greatly distended. Noises in head had become greatly aggravated. Occasional violent pain in orbit. No impairment of hearing. Patient refused operation.

VIII. IX. X. KNAPP (discussion of Pooley's paper): Three cases, in all of which the common carotid was ligated. Bruit, exophthalmos and chemosis relieved, but the optic nerve went on to atrophy.

XI. CLAIBORNE (discussion of Pooley's paper): Case like Pooley's. Applied pressure bandage, kept up for eighteen months. Mixed treatment internally. Perfect cure.

XII. BARRETT and ORR: Male, aged fifty, ten weeks before observation fell while intoxicated. Unconscious from 24 to 36 hours. In hospital three weeks. No evidence of organic lesions. Six weeks after injury complained of buzzing in the ears, and a few days later exophthalmos. Vision, 6/36. Lower lid everted, marked exophthalmos in middle line, conjunctiva of lower lid engorged and swollen, fundus veins dilated.

External canthus divided and orbit explored, finger pushed behind eye, where a pulsating mass was felt. Later a marked bruit was heard over temporal bone and the eye synchronous with the pulse. Two days later eye became stationary with many hemorrhages and distended veins in the fundus. Progressed. Ligation of common carotid. Steady improvement, exophthalmos diminished.

XIII. RUBEL: Young man. Three and one-half years ago almost lost vision in left eye and the hearing in both ears following a severe blow on the head. Some months later developed the complete picture of pulsating exophthalmos (left).

Ophthalmic findings: Arteries normally full, veins dilated, stasis. Atrophy of papilla. Numerous yellowish flecks on fundus, from papilla to periphery.

Patient observed for two weeks. Then left common carotid ligation by Kraske. Tension of globe (Schiotz) on both sides before operation, 20 mm. Hg. No difference noted on successive days. Immediately after ligation the tension (left) fell to 8 mm. At close of operation 11 mm. Nine days later, left 15–17 mm. Hg; 17 days later, left 15 mm., right 16 mm. Hg.

Retinal changes cleared up with disappearance of exophthalmos. Nine and one-half months later all right except for optic atrophy.

XIV. E. ELIOT, JR.: Man, aged fifty-one, admitted October 15, 1909. Moderately alcoholic. Ten years ago piece of steel entered right cornea resulting in ulceration and partial loss of sight in that eye. Five weeks before admission was assaulted, receiving blow on left zygoma with some heavy instrument. Unconscious for a short time, bleeding from mouth and fractured nose. Walked home. Left eye was swollen and nearly shut, but gradually better, and seventeen days after injury he had some use of eye. Two weeks ago he noticed protrusion

of left eyeball, and during past week eversion of lower lid. Throbbing pain in eye with each heart-beat and a murmur or buzzing sound could be heard distinctly in left ear. Severe pains shooting from left to right side of head. Dizzy at times. No vomiting.

Examination.—Marked exophthalmos, left eye. Eyelids swollen, between them a ridge of red conjunctiva one inch long and one-fourth inch wide. Eye reacted to light and slightly to accommodation. Pulsations could be seen and felt. Continuous blowing murmur could be heard over entire skull and vessels of left side of neck. This sound was exaggerated with every heart-beat, and loudest over left eye. Ophthalmic examination showed marked swelling of papilla and œdema of retina. Veins enlarged and tortuous. Arteries small.

Operation.—Ligation of common carotid, just above omohyoid. No sign of interference with cerebral circulation. Intracranial murmur ceased and exophthalmos disappeared rapidly; at ten days little remained. Three years later, eye-sight has gradually improved. Continued use in reading results in headache. No exophthalmos.

XV. GIBSON: Showed photographs of a case where he had ligated carotid in 1904. There had been some intracranial operation, during which some trauma was inflicted, and further operative measures were abandoned on account of severe hemorrhage. On admission both eyes were bulging, and the sight of one eye was lost. Common carotid tied, and in course of time patient recovered entirely as far as appearance of eyes was concerned.

XVI. FLEMING and JOHNSON: Man, aged forty-seven, previously good health. September, 1907, fell on back of head. Unconscious for few moments. No reason for fall. Walked home. Well until November, when he noticed he could not see objects placed on left side. Found to be suffering from hemianopia. No proptosis then, but soon afterwards beating noise.

April 19, 1908, noticed that left eye was prominent and inflamed. This increased. April 29, left side proptosis, lids swollen and congested. Chemosis, especially lower fornix. Pupils equal and reacted normally to light and accommodation. All movements of left eyeball are limited. Pulsation of eyeball, bruit, etc. Pulsation and bruit arrested by compression of common carotid. No cranial nerve affected, except optic (left hemianopia), and right hypoglossal, the tongue deviating slightly to right.

May 14, left common carotid ligated with silk in continuity, at level of cricoid. Pulsation immediately arrested, and never returned. Proptosis gradually disappeared. June 10, sat in chair and June 11 became aphasic, with right facial paralysis, tongue deviating strongly to right, and weakness of right arm. Better next day and gradually improved.

September 29, still slight proptosis. No pulsation detected. Faint systolic murmur heard over eye. Conjunctival vessels injected. Left eye vision 6/6. Hemianopia unchanged. No facial weakness, but tongue still deviated to right. Weakness of right hand.

Late onset of cerebral symptoms supposed to be due to extension of clot into some small branches of middle cerebral.

XVII. GWYNNE WILLIAMS: No operation. Male, aged twenty-nine, has had dilated veins over left eye ever since he was a baby. Fell on head when nine and had concussion. Left eye "weak," but became prominent only in last 11 months. Has twice had subconjunctival hemorrhages, when eighteen and twenty-five years old.

Exophthalmos, chemosis, eye pushed forward and outward, all motions limited. No diplopia. Bruit, systolic. Eyeball pulsates. Pressure on common carotid diminishes swelling and stops pulsation. No pulsation seen in veins of retina.

XVIII. LAZAREW: Lazarew's case was sixth in Russian literature, among 150 known. Patient, seventeen years old. Three years ago noticed that right eye was becoming more prominent, with noticeable swelling at inner angle and pulsation. Came on suddenly on arising in the morning. No trauma.

Common carotid ligated. Pulsation stopped immediately, but the exophthalmos persisted, and in the evening the patient complained of pain in the teeth of both lower jaws, and a slight pulsation in the eye began again. No improvement after five days, so Lazarew ligated the superior ophthalmic vein.

Lazarew believes that he is the first to perform this operation. Cerebral disturbances followed, but subsided after 14 days. Cure complete.

XIX. SAVARIAUD: Small girl had head squeezed between a large plank and a boat, had hemorrhage from right ear and nose. Later, paralysis of the abducens on the right side, exophthalmos and continuous murmur with systolic emphasis. Slight pulsation. Injections of gelatin after Lancereaux's method failed.

XX. BEDELL: Man, aged thirty-nine, was riding on an open street car, May 31, 1913, which was derailed and thrown against a tree. The man was thrown to ground and struck his head. Next day dazed, with all signs of true fracture of base of skull, bleeding from nose, ears and mouth and vomiting. No paralysis of face, all reflexes normal. Mind cleared in about four days and memory gradually returned. Hearing on left side lost, and slight ptosis of left upper eyelid. Constant dizziness and headache. Five days after accident patient felt something "like electricity" in upper angle of left orbit, which was found to be definite pulsation and bruit. At that time there was marked diplopia, dilated pupil and beginning proptosis.

May 7, 1914, patient complains of constant noise in head and terrible headache. Right eye vision, 20/30. Decidedly proptosed. Outward motion limited. Veins of lids, especially at inner corner of upper lid, prominent and tortuous. Pupil active and normal. Retinal vessels overful and veins especially. Congestion of disk. No pulsation of globe.

Left eye vision, 20/30. Proptosis more marked than right. Extremely large mass of tortuous and dilated veins on upper lid. In the upper and inner corner of the orbit is a large dilated vessel (2 cm. in diameter) transmitting a distinct bruit. Visible pulsation of globe. Pupil normal. Entire conjunctiva congested. Retinal veins congested and tortuous. No hemorrhages. Field of motion limited. Eyeball turned in 30 degrees, abducens paralysis. Bruit most intense over supra-orbital ridge, although felt over entire head. Systolic blowing murmur heard over same area is stopped by carotid pressure. Left ear, thin gray retracted membrane. Hearing greatly reduced. Large perforation of septum of nose. Wassermann and Noguchi negative.

March 29, pressure on left eye partially reduces it, causes strong pulsation and patient complains of dizziness. Carotid pressure or pressure on the ophthalmic vein deep in left orbit stops pulsation and bruit. Lying down increases headache, but does not affect exophthalmos. Diplopia.

October 4, no improvement. Patient refuses operation.

XXI. G. J. PALEN: Woman, aged sixty-five. October 18, 1908, complained of pain in right eye, extending into head, photophobia and lachrymation. In 48 hours

there occurred a vesicular eruption along course of supra-orbital nerve (right). This eruption disappeared in 3 or 4 days. October 21, pain, which had recurred at intervals, became more intense and she was unable to open the right eye. No inflammation of eye at this time. Had interstitial nephritis, atheroma and hypertrophy of heart for some time.

Examination (November 9).—Marked ptosis, proptosis. Pupil dilated and eyeball deviated outward and somewhat downward. Vision below normal, optic disk swollen, veins tortuous and engorged. For some time prior to her attack she had had a very intense noise in head which was continuous but seemed increased at every heart-beat—"a rushing sound like rushing water." This did not cease until onset of pain October 18. At age of eight she was struck on head by handle of pump, but had no trouble from it. Scarlet fever, whooping cough, varioloid, grippe three times. No acute illness prior to this condition.

Condition rapidly became worse. Bruit heard, plainest over eyeball and right antrum, less intensely so over right side of head, and with diminished intensity downward along side of neck. Had sound of tubular breathing with marked systolic accentuation. Pressure on right carotid checked bruit, and eye could easily be pushed into orbit. Pressure on left carotid gave no result. No pulsation at this time. Refused operation. In bed, recumbent, carotid compression used. November 13, the eye protruded markedly and was fixed in medium position. Marked chemosis, complete ectropion of lower lids, cornea insensitive and dull, swelling of disk very intense. At inner upper angle was a soft compressible tumor and the veins above and to temporal side were engorged. Distinct pulsation felt over this tumor, and beginning pulsation of eyeball noticed. Condition became much worse. Bruit heard over entire head loudest over right orbit and right and left mastoid regions and much louder than before. Potassium iodide in increasing doses. No result from digital compression. Slight improvement but vision was gone. Treatment continued at home. Proptosis lessened and pulsation disappeared about latter part of January. March 1, had severe hemorrhage from left nostril, after which eyeball receded greatly. Bruit still heard over entire head, loudest over lateral sinus. January 24, bruit disappeared, still partial ptosis, slight increase in ocular movements. Vision 0, optic nerve atrophy. No engorgement of veins about orbit or at inner angle.

Peculiarity of this case was the intensity of the bruit along course of the lateral sinus. The intensity of bruit lessened markedly above and below this line.

XXII. MATTHEWSON: Man, aged thirty-two, thrown from top of car October 8, 1910, fracturing base of skull. November 5, left eye proptosed with complete ptosis. Considerable swelling of conjunctiva and restricted motion of globe. Fundus negative. Vision fingers 8 ft. in upper field, lower field lost. No pulsation of globe.

December 20, veins of upper lid much dilated, ball pulsated, slight pallor of nerve, slight dilatation of retinal veins, no bruit, occasional headache.

March 11, vision almost gone. August, condition more marked. Loud blowing murmur heard over greater part of skull.

September 5 common carotid tied. Month later, little proptosis, no bruit or pulsation.

XXIII. BARBIERI: Italian man, aged forty-three. April 24, 1907, had intense pain in temporal region. Next day exophthalmos, and one month later the right eye pulsated. Injection of 5 per cent. gelatin tried without result. October 21, ligature of right common carotid. Exophthalmos and pulsation continued.

January 8, 1908, the left common carotid was tied. April 4, when last seen, exophthalmos present, movements of eyeball moderately free, pupil inactive to light, slight headache, subjective noises continued.

XXIV. MAYOR SPENCER: Gunner, twenty-three years old, struck by fist in right eye, June 12, 1906. Black eye, skin not broken. Three weeks later began to have buzzing noises in head, becoming worse. On examination six weeks after trauma, pulsating swelling, with thrill and murmur, detected in orbit. Treated by compression of carotid and calcium chloride internally, but swelling increased in size. Marked proptosis, with some swelling of lids and lachrymation. Pulsating swelling about size of hazel-nut projected under upper eyelid. Expansile pulsation, distinct thrill and loud musical whirring murmur, and it seemed that the main bulk of the tumor was deep in the orbit, while the small swelling was only an offshoot. Vision 6/6 in each eye, slight diplopia on looking upward and to the right. Fundus and conjunctiva normal.

December 5, right common carotid ligated. Pulsation entirely disappeared on tightening the ligature, but a slight thrill could still be felt over the right eyebrow. Pulsation in the small swelling reappeared slightly six days later, not deep in orbit. Excised fusiform dilated vessel. All pulsation and thrill at once disappeared. Well since, and no recurrence (March, 1907). No trace remains except a slight fulness in right orbit.

XXV. ORLOFF: Pulsating exophthalmos developed six months after a deep wound in region of left parietal and temporal bones in a thirty-year-old patient. Successful result obtained after ligating ophthalmic vein in the depths of the orbit after temporary resection of external wall of orbit.

XXVI. XXVII. XXVIII. BUCHTEL: Operated August 13, 1912. Male, struck on head with a pitchfork three months before. Buzzing sound in head, and in a few days left eye protruded. Well-marked exophthalmos, forward and downward. Pulsation of the eyeball and the mass at the upper and inner angle of orbit, with continuous bruit and systolic accentuation over brow and temple. Complained of noise, diplopia and headache. Fundus negative.

Operation.—Incision, eyebrow, angular. Superficial and temporal veins tied and superior ophthalmic ligated as far as possible in orbit. More œdema at first, but no bruit, pulsation or fundus change. Exophthalmos gradually lessened. Vision 20/20.

Also reports two other unrecorded cases. One, a double exophthalmos, cured by ligation of common carotid.

The other, unilateral, died after ligation of common carotid.

XXIX. HALSTEAD and BENDER: Man, twenty-four years old. Wagon-wheel passed over his head just back of the eye, January 29, 1909. Unconscious three days. Left eye bulged more after accident than on entrance to hospital, when it was turned sharply toward nose and appeared paralyzed. Lids swollen and impossible to close upper lid, move the jaw or to swallow. Roaring noises synchronous with the heart-beat could be heard from the time patient regained consciousness until he entered hospital. In bed two weeks after accident, during which sight in left eye became much impaired.

Examination (August 27, 1909).—Left eye turned in 45 degrees and very prominent, $^{3}/_{8}$ inch further forward than the right. Veins on upper lid very large and tortuous. Blood-vessels of sclera also dilated. Cornea vascular, and over a 4 mm. area in centre is a fairly dense cicatrix. Vision: right, 20/20; left, 20/30. October 10, pulsating tumor felt over lid and inner angle of orbit.

Bruit heard over left temporal region and roaring noises complained of by patient, heard most distinctly over left ear. October 14, left internal carotid ligated near origin with chromic gut. At present left eye turns in and there is some exophthalmos but no bruit.

XXX. LANE: Male, struck on head by brick, fracturing nose, three months ago. Twelve days later ectropion of lower lids, marked œdema. Vision: right eye, 8/200; enormous dilatation, retinal veins; small hemorrhages about disk. Pulsation, bruit, exophthalmos. Blowing sound, left ear. Pulsation continues over left temporal region with accentuated systolic murmur. Only general treatment and potassium iodide. June 10, patient sat up for first time. Five A.M. June 11, became aphasic with right facial paralysis. September 2, no pulsation, faint systolic murmur, vessels of conjunctiva bright red color. Vision: Left eye, 6/6.

XXXI. MAHER: (1) Man, aged thirty-five. Ten months ago had had a blow on head with a stick. Was unconscious 30 hours and dazed a week. Three weeks after injury right eye began to protrude and throb with marked pulsation, controlled by pressure on right common carotid. Bruit over eye and temporal region. Marked engorgement conjunctival vessels, œdema of conjunctiva, pupil dilated, retinal veins dilated and tortuous, marked œdema of optic disk and retina. Headache and whirring noise in head. Right internal carotid tied. Pulsation ceased at once. Exophthalmos diminished. Three years later no exophthalmos, slight pallor of disk, and only occasional headache.

XXXII. (2) Man, aged nineteen, fell 45 feet, fracturing base of skull. Unconscious several days. Six weeks after injury left eye began to protrude and for some weeks progressed, then gradually subsided. The right eye became more prominent. Pain and noises in head. Right eye proptosed and convergent, conjunctiva œdematous, vessels full; limited motion of globe up and down, no motion outward; pupil normal, retinal vessels slightly tortuous and dilated. Vision, 5/18. Left eye not proptosed, movements up and down limited. Pupil dilated. Disk pale. Vision, 5/21. Loud bruit over right eye and temple. Left internal carotid tied. One month later, marked subsidence, eye moved up and down but not out, headache better, but bruit persisted, vision same.

XXXIII. WEINKAUFF: Widow, aged eighty-four, with no known reason became sick, April 16, 1908, with severe headaches; next day frequent vomiting appeared, and unconsciousness. Consciousness returned after a few days, but speech was still somewhat confused at first. It was noticed that the left eye was markedly pushed forward, and shortly afterward the right eye became affected in the same manner. The patient complained of serious disturbances of vision.

Patient seen first on May 5, 1908. Consciousness normal. No headaches now and none present subsequently. Ringing in the ears exists unchanged since several years, deafness for a longer time. Old age pronounced. Arterial rigidity is not exceptionally pronounced, pulse irregular. Remained in about this condition for next six months, then died from sudden cardiac failure.

Examination.—Slight facial œdema, also œdema of the overhanging upper lids. Globes directed downward, slightly divergent. Completely immovable and proptosed. They could not be pushed backward. The œdematous bullar conjunctiva pushed out between the lids. Media clear. Papillæ are cloudy and swollen. Numerous small hemorrhages of the retina. Retinal veins dilated only moderately and slightly tortuous. Sensibility of cornea gone. Fingers counted on both sides at ½ M.

In June the œdema and exophthalmos began to go down slowly. In the upper inner angle pulsation is clearly felt, deeply situated. Bruit heard synchronous with the arterial pulse over the upper part of the orbit, changing to a blowing murmur during diastole, heard loudest over nasal side. This murmur gradually increased in intensity in the next few days, "*bau-sch, bau-sch.*" The patient did not notice this murmur, complaining only of the former continuous singing in the ears. Left vision now 0.

July, pulsating nodules began to form at inner and upper angle, which gradually became smaller. August, right side showed hardly any pulsation. Compression of the right or left carotid produced no changes. Double carotid compression not tried. Pulsation of the bulb itself was not noticed, nor was pulsation of the retinal vessels seen. October, pulsation gone entirely. November, bruit completely disappeared. No exophthalmos. Right eye counted fingers at 2 M.; the papillary swelling had gone down. Left eye entirely amaurotic. Movability of the bulbs remained limited. Death in December. No autopsy.

XXXIV. HILDEBRAND: Young man, in 1893, fell from a ladder and broke his arm and sustained cerebral concussion. Blind in left eye on recovering consciousness. Four months later the left eye protruded slightly. Pupils dilated and motionless, optic nerve white and glistening.

Diagnosis.—Laceration of optic nerve. One-half year later the globe was pushed very far out. Upper eyelid swollen with marked enlarged vessels. Root of nose swollen and pulsation was felt there. Pulsating vessels ran backward from here. Globe could be easily and painlessly pushed back, and was directed inward and downward. Retinal veins dilated and tortuous. Arteries normal. Loud whistling sound heard over entire head with stethoscope, loudest between outer angle of left eye and left ear. Bruit disappears when carotid in neck (left) is compressed. Patient complains of the bruit, which he hears strongest in front of left ear.

Treatment.—Carotid compression tried one year after injury, for nine weeks for one hour a day, carrying out the same treatment himself later at home. No result one-half year later. Patient seen by Hildebrand seventeen years after injury. Above condition. Globe shows slight pulsation, and hardly moves upward and outward. Lids are not swollen or œdematous. Vessels of forehead greatly distended and tortuous. Right eye normal, veins slightly distended. Both superior ophthalmic veins are involved. No operation.

XXXV. HALSTEAD: Male, aged thirty-six, struck twice on left temporomalar region with a hard instrument, February 10, 1910. Unconscious a short time, then walked home. Blood from nose and ears. Facial paralysis next day and roaring in the ears. Two months later, when left eye was enucleated for panophthalmitis, the orbital contents prolapsed. Vision, 20/40. Diagnosed as pulsating tumor of base of brain, probably aneurism. October 5, 1910, stump of left eye removed. Right eye signs of beginning venous stasis. Roaring in ears heard in head; long, loud bruit over malar regions. Common carotid and two divisions of superior thyroid ligated. Bruit disappeared immediately. No brain symptoms.

XXXVI. RANSOHOFF: Man, blow on right temple during fight. No unconsciousness or dizziness (October 18, 1905). On November 28, he suddenly noticed that he could not see out of right eye, which became swollen and prominent, until within two weeks he could not close the lid. Ringing and buzzing in the head, occasionally pain in forehead.

Examination.—Man, aged twenty-two, farmer. Healthy. Abducens paralysis. Pulsating exophthalmos. Ocular media clear.

Operation.—Common carotid, external and superior thyroid tied with catgut. Superior thyroid divided, common carotid divided. Abducens paralysis persists. Vision has improved much, subsequently the central scotoma disappeared, and neuritis cleared up. Cure.

Diagnosis.—Arteriovenous aneurism of internal carotid, rupture of abducens.

XXXVII. R. J. SCHAEFER: Woman, aged seventy-four, suddenly taken with vomiting and distress January 10, 1907. Went to bed. Soon after felt severe headache, spreading to right eye. Next day noticed a brownish circle around the lids of right eye, and January 12 paralysis of upper lid occurred. No unconsciousness, but insomnia. Noises in head, and her previous deafness grew greater. Sees well. No previous serious illness.

Examination.—Nothing in heart, lungs or other organs. Several suffusions on right side of face, especially around right eye. Ptosis-exophthalmos, chemosis. Total ophthalmoplegia. Sensitiveness to pressure on the globe. Pulsation not present. Amaurosis. Retinal ischæmia.

Operation (January 21).—Chloroform. Protrusion now tremendous. Pulsation now evident. Bruit over right eye and side of head. Attempt made to ligate superior ophthalmic vein, according to Sattler's method. Great hemorrhage, and the vein could not be found. Tampon. Tried to find inferior ophthalmic vein. Could not. Had to tampon and give up operation.

Digital compression of common carotid tried at intervals. Suddenly, January 28, she could sleep and the bruit and noises no longer existed. Thrombosis of sinus thought to have occurred. The pulsating exophthalmos continued and the eye was nearly dislocated from the orbit. Enucleated January 30. Did not ligate common carotid at first (in disease) because he feared to do so on account of general arterial sclerosis. Died about February, 1910, from arterial disease.

XXXVIII. OPPENHEIMER: Had seen a case (erectile tumor) in which the common carotid was ligated. Secondary hemorrhage resulted fatally.

XXXIX. KRAUPA: Man, twenty years old, jumped from a spring board into a swimming pool. On coming to the surface he noticed a remarkable ringing in his left ear, which became more pronounced in the next few days. Also began a typical pulsating exophthalmos of left eye. Patient very alcoholic, otherwise sound. Short systolic bruit at apex. Hearing was slightly impaired in left ear. Typical pulsating exophthalmos in left eye. Media clear.

Digital compression carried out for a long time, and then Weil ligated the common carotid. Three months later high-grade exophthalmos still persisted, but the pulsation and the subjective symptoms have disappeared since ligating.

Five years later he came complaining of abdominal pain and examination showed very slight exophthalmos. He confessed having had syphilis one year before his eye trouble. Wassermann positive.

Cornea clear, movement normal. Pupils unequal, incomplete reflex. Thickening of walls of retinal veins, which was not altered by 606 and other treatment for two years. Increased blood-pressure in the veins assumed to be the cause. No exophthalmos or pulsation, but the retinal veins are still thickened.

XL. C. S. MERRILL (personal communication to Bedell): Woman, aged fifty, fell from wagon, striking the back of her head, July 5, 1909. When seen had left-sided chemosis, external exophthalmos, and pulsation. Aneurismal bruit. Compression of carotid stopped the bruit. Vision: right, normal; left, *nil.*

Dr. A. W. Elting ligated left external carotid. All symptoms relieved and eyeball returned to normal position. Some months later, vision: right, 20/20; left, objects to outer side; optic atrophy.

XLI. SANTOS FERNANDEZ DEZ BALBUENA: Man, aged forty-seven. Forty-two days before observation he was struck by a hammer, unconscious for 3 days. On recovering consciousness he had noise in the head, with moderate exophthalmos and ptosis. Pupil normal. Conjunctiva congested. Compression of common carotid caused disappearance of symptoms. A week after observation gelatin injections were started (intravenous), 2 per cent., and 2 per cent. NaCl. One month later the condition was much better. Pulsation stopped and exophthalmos disappeared.

XLII. LYSTAD: Boy, aged fifteen, stoker on steamer, was wounded August, 1902, by a revolver in the right nasal aperture. Right-sided ptosis noticed on admission to hospital, besides a left spastic hemiparalysis with incomplete anæsthesia and much disturbance of hearing in left ear. Left hospital after three months and eight months later resumed his work.

About two years after his accident he gradually began to notice swelling over the right eye, and in the next year gradually increasing exophthalmos and bruit. Patient states that the swelling is greater just before a storm—"barometer." Five years after trauma he received a blow with the fist over the right eye. Came to clinic for treatment July 27, 1907.

Typical pulsating exophthalmos. Movement of eyes normal. Stasis of retinal veins, no pulsation. Subjective and objective vessel bruits disappear almost entirely by compression of right carotid.

September 17, 1907, right internal carotid was ligated. Not sufficient, so the external carotid and jugular vein (internal) were also ligated. Great improvement seen at first, subsided during the next week, and in the beginning of 1908 the pulsation and exophthalmos were about as before ligation, and patient was unable to work.

January 24, 1908, orbital operation performed (Prof. Schiotz). The pulsating mass in upper inner angle was ligated. There were a great number of very tortuous, thin-walled veins. Operation difficult. On removing dressings next day there was seen an enormous protrusion of the bulb and its surrounding structures. Intense headache and pain in eye. Subjective bruits unchanged, pulse slow, sensorium clear.

A slight swelling in the neighborhood of the left eye subsided after a few days. After three weeks the protrusion was distinctly smaller; pulsation and objective bruits disappeared. The subjective bruits were noticeably less, but severe headache and slow pulse persisted.

The exophthalmos slowly disappeared during the following weeks, the swelling over the eye grew less tense, and the pulse normal.

Two months later he stood up. Slight posterior synechiæ, fundus not clear, hemorrhages. Tension increased, 51 mm., Schiotz. Fingers at 2 M. and field of vision concentrically greatly narrowed. After several months was able to work. Absolute glaucoma.

Eye enucleated at request of patient December, 1908. No headaches subsequently. The subjective bruits come at times but very slightly. Otherwise normal.

XLIII. RISLEY: (1) Knocked unconscious by fist blow on the ramus of right jaw. Four weeks later pain in head, diplopia and confusion. Proptosis of right eyeball about 10 mm., swelling of lid, conjunctiva chemotic with full

veins near inner canthus. Motion limited except downward. Systolic pulsation best heard over right eye. Vision, 6/12. X-ray negative. Still under observation.

XLIV. (2) Man aged thirty, three years before had had his head caught between trolley car and express wagon. Unconscious seven weeks. Abducens paralysis, slight proptosis of right eye. Loud blowing systolic bruit heard over entire skull but loudest over right eyeball and left frontal. Bruit lost on right carotid compression. X-ray negative. Still under observation.

XLV. HASLAM and HIRD: Woman, aged twenty-four, husband died of pulmonary tuberculosis. No history or signs of syphilis. Two days ago had pains round her right eye, and noises in her head. Came on suddenly. Went to work next day and noises became louder then and the eye became prominent. No pain. Sight was bad but improved later. Went home to bed and was sick several times.

Examination.—Proptosis (right). Subcutaneous and subconjunctival ecchymoses. Pulsation, eye pushed forward in systole. Double bruit heard over eyeball. Visible pulsation over right side of neck along great vessels. Bruits could be heard over whole of skull. Pressure on right common carotid stopped noises (subjectively), but they could still be heard by stethoscope. Eyeball freely movable. Pupils equal and react normally. No signs of arterial disease. Six days later (after admission) she began to have paralysis of external rectus.

Six weeks after onset right common carotid was ligated at level of cricoid. Thyroid gland much enlarged. All symptoms improved except pulsation (very slight), and patient could still hear slight noise, and double bruit had become only systolic. Ten days later the noises and murmurs became worse, and next day the double murmur was present again. Abducens paralysis still persists.

Right internal angular vein was ligated one month later. Noises much less for three days afterward, and no thrill or pulsation was present. Not followed by thrombosis of cavernous sinus.

Eight months later patient has proptosis, pulsation, abducens paralysis, congestion of veins, bruit. Hearing on right side is defective. No visible change in optic disk. Right vision, 6/24 (with glass). Right fundus shows congestion. Pulsation in arteries of neck above ligature.

XLVI. GINSBURG: Boy, aged eighteen, struck on head with an iron object, August 26, 1910. Unconscious 15 minutes. Hemorrhage from mouth and nose. St. Praes (three days later). Complains of headaches, very severe and worse at night. In the left eyebrow is a small skin wound. Bony rim is sensitive and swollen. Large ecchymosis under left lower eyelid. Left eye otherwise normal. Right eye proptosis, immovable, lids congested. Pushing the globe backward causes pain. Bulbar conjunctiva is not sensitive in the nasal region, also on temporal side. Pupil medium wide, light reaction gone (direct and consensual). Disk cloudy, boundaries hazy. Fundus congested. No pulsation of vessels. Veins dilated and tortuous, arteries contracted. No hemorrhages. Amaurosis, vision 0.

Diagnosis.—Fracture of base and rupture of optic nerve in optic canal. September 4, strong pulsation in retinal vessels noticed for first time. Pulsation of globe, synchronous with heart systole. Soft, blowing murmur heard over eye. Complains only of severe headaches. Pulsating exophthalmos.

September 10, complains of noise in right half of head, disturbing sleep. Skin over temple, upper lid, and forehead anæsthetic. Cornea and conjunctiva

insensitive. Compression of right common carotid causes subjective and objective bruits to disappear.

December 7, ligation of common carotid below omohyoid (Prof. Schimanowsky).

December 8, same bruit, but weaker.

December 9, blowing bruit over forehead.

December 12, proptosis unchanged, no infection in wound.

Operation (March 27, 1911).—Ligation of vena angularis, frontalis, supra-orbitalis and palpebralis superior. All these veins divided. Could not see the superior ophthalmic vein on account of the thickening of other veins, especially the lachrymal. Ophthalmic vein grasped with Pean, also lachrymal. Levator palpebræ superioris and tendon of the trochlearis divided to allow access to the ophthalmic vein. Peans left in place.

March 30, bleeding from left ear. Proptosis greater than before operation. St. Praes, April 17. Complete ptosis. Sensibility of skin and cornea slightly improved. Proptosis entirely gone. No ocular mobility. No pulsation. Vision, 0.

Microscopic examination of exsected veins shows thickening, three layers. Hypertrophic process is especially evident in middle layer, which consists of strong muscle fibres. Weigert's stain for elastic tissue demonstrated its presence.

XLVII. FRIEDENWALD: R. S., colored, aged twenty, applied for treatment November 11, 1909, because of pain in right eye, which she said had been bulging out of socket for eleven or twelve years. Pain had begun in past year, condition otherwise unchanged. No history of trauma. For some months had heard a thumping noise in right ear, especially at night. Hearing perfect.

Present Condition.—Right eye displaced forward and downward. It is very prominent and pulsates so markedly that pulsations can be seen many feet away. Easily palpable. Right eye about 12 mm. lower than left, and forced forward at least 5–6 mm. with each pulsation. Eyeball easily and painlessly pushed back into socket. Vision: Left, 16–15; right, 16–200. Ocular movements in right eye normal except upward. Diplopia. Pupils equal and react to light. Lids, conjunctiva and anterior part of eyeball are normal. No tortuosity or congestion of retinal vessels. Right disc paler than left. No bruit about the orbit. At the posterior margin of left sternomastoid is a short well-marked blowing sound systolic. At times a blowing sound is heard along margin of right sternomastoid. X-ray shows enlargement of pituitary fossa, with irregularity. Right orbital cavity larger than left.

XLVIII. RECLUS: Woman, syphilitic, entered hospital July 18, 1906, for affection of the orbit. Treated for several months previously for syphilis. Five years ago began having rebellious headaches, especially at night.

February, 1906, was taken suddenly with fever and violent pains in the head, diagnosed as meningitis. Then the inner angle of the left eye began to be a little more prominent than the right, prominence consisting of pulsating vessels. One night later she was awakened by a sound like a locomotive blowing off steam.

Examination.—Exophthalmos, swelling œdema of upper lid, with a network of dilated vessels in it. Pulsation and thrill over these tissues, and down the carotids on both sides. Bruit heard everywhere over skull. It was a continuous whistle, with systolic accentuation. She complained besides of another bruit, like the chirping of a bird. Sugar and albumin in urine.

Digital compression of common carotid. Slight betterment, but later recurred.

Gelatin injections, Lancereaux and Paulesco, following the first therapeutic suggestions of Carnot in the coagulating power of gelatin. Lancereaux cured a case by this method and presented him to the Academy. Twenty-one injections given. One per cent. solution of gelatin in serum at first, then 2 per cent., as the 1 per cent. was found not active enough. Five per cent. is painful and causes a rise of temperature. Two per cent. caused a slight rise. Injection into the muscles, not subcutaneous. Slight improvement was noted. Twenty-one more injections were given, and the result was more encouraging. Altogether, 81 injections of 40 grammes of solution were given, when she was taken with complete ophthalmoplegia (left) and ptosis. Regarded as specific and treated with gray oil injections. No improvement, and she is blind, with retinitis of that eye. Gelatin injections resumed, and after the fourth one she had acute swelling of upper lid with pain. Ice used locally. Pain disappeared and the vessels felt hard, with no pulsation. Pulsating exophthalmos disappeared. No chemosis, or vascular tumor. The intracranial whistle persisted and the attacks of headache. Glaucoma of left eye.

Left common carotid ligated March 19, 1908. Intracranial bruit disappeared next day. Two months later well except for ptosis and ophthalmoplegia and blindness.

May, 44 days after operation, suffered an apoplectic stroke and died.

Postmortem.—Cavernous sinus full of hard clots and dilated to size of small nut, with the internal carotid ruptured 4–5 mm. Common carotid and internal carotid empty down to the place of ligature, where there is a clot about 2 cm. long. A second rupture of internal carotid into cavernous sinus existed on the other side, fresh. She had been having symptoms on right side for a short time, bruit, headache and pain in right globe.

XLIX. WILDER: W. C., aged forty-two, American, admitted October 31, 1910. Three weeks previously was waylaid by a thug and struck over right eye. Unconscious. On recovering noticed lids of both eyes were swollen. Sight not impaired, but diplopia was present. Severe pain in right side of head, intermittent. These attacks became more frequent and severe and he came to hospital. Noticed roaring in ear on recovering consciousness, like a steam exhaust. Right eyeball began to protrude and swelling of lids did not diminish. The pain in the head became constant, radiating to back of the head and spine.

Examination.—Right exophthalmos, conjunctiva swollen and œdematous. Conjunctiva veins engorged. Marked distention of angular vein at superior border of orbit. Cornea clear. Pupil dilated and inactive to light and accommodation. Mobility of eyeball reduced to slight abduction only. Levator palpebræ also powerless. Vision: Right, 20/60; left, 20/20. Fundus normal except for engorged veins. Optic disc redder than normal. Left eye normal. Hearing normal. Marked bruit, systolic accentuation, heard over right side of head and eye, most pronounced over zygomatic arch. At times faintly heard over left temple and eye. Bruit and subjective noises stopped on compression of common carotid. It was doubtful whether there was ever any pulsation of orbital contents, even when leaning over.

Operation (November 10, 1911).—Dr. A. W. Bevan. Ligation of common carotid. Bruit stopped immediately. On recovery from anæsthetic noises were not heard. Pain in head persisted for a week and gradually subsided Exophthalmos disappeared slowly. Swollen conjunctiva required massage and astringents. Mobility of eye slowly returned, pupil became normal. Vision, 20/30 at

five weeks. Wilder thinks this was an aneurism of the carotid (cavernous portion) not communicating with the sinus.

L. (2) C. O., aged thirty-eight, laborer, admitted November 22, 1910. Struck on back of head by beer-bottle 5 or 6 months ago. Unconscious for some minutes. Again became unconscious, trephined. Regained consciousness after operation. Left hospital well after three weeks. Again struck on back of head with iron bar, unconscious. Scalp wound sewed, well. Two weeks later began to have headaches and noises in head and right ear. These continued steadily, and five weeks later noticed protrusion of right eye, later pain and lachrymation. Came to hospital.

Examination.—Exophthalmos (about 10 mm.), directed downward and outward. Mobility of right eye limited to abduction and outward rotation. All muscles supplied by third nerve seemed to be paralyzed. Fourth and sixth normal. No facial palsy. Pupil dilated. Ptosis. Chemosis of conjunctiva and fornix, with engorgement of veins. Angular vein not markedly distended. Fundus normal except for some engorgement of retinal veins. Vision: Right, 20/40; left, 20/30. Tension of right slightly plus. High pitched bruit, synchronous with heart-beat, heard over entire head, but loudest over temporal region of right side of right eye. Blowing bruit, accentuated in systole. Very slight pulsation of orbital contents seen and felt. Orbital pain and roaring in head, "like a waterfall." Hearing normal.

Bruit and head noises ceased on compression of common carotid.

Diagnosis.—Aneurism of internal carotid in or near the cavernous sinus.

Operation.—Ligation of common carotid. Dr. A. D. Bevan, December 12, 1910. Bruit stopped on ligation. Patient relieved of noises and pain at once. Exophthalmos gone in two weeks Chemosis better. Partial recovery from the third-nerve paralysis. Pupil still enlarged and immobile. Retinal veins still enlarged. January 28, 1911, hissing noises began occasionally, accompanied by exophthalmos, receding again. Some weeks later faint bruit heard over right mastoid and temple.

Internal carotid ligated April 5, 1911. When ligature was placed around vessel bruit did cease (high bifurcation). Found and ligated. Paralysis of muscles of left forearm and hand, difficulty in speech. No amnesia. Gradual return to normal. Exophthalmos still slightly present. Mobility good, right pupil 1 mm. larger than left, and mobile. Vision: Right 20/50; left, 20/20.

LI. IPSEN: Woman, aged forty-nine, came to Rovsing's service June 1. Enlarged cervical glands of left side. Two miscarriages.

Lately has had severe headaches back of ear twice a year, causing shooting pains at the vertex of the head, and accompanied by vomiting. Normal in interval.

March, 1911, she fell against a tree and injured left side of head and neck, but there were no signs of basal fracture or unconsciousness.

May 7, suddenly taken sick from no apparent cause. Intense pain in right side of head, with buzzing and sounds like machinery in operation heard. Vomiting.

Examination.—Nothing abnormal seen, but next day the right globe was protruding, conjunctiva injected and eyelids were swollen. These symptoms increased in intensity in next few days, and globe became immovable. Ten days later pulsation of globe and eyelids was noticed. This pulsation stopped upon

compression of common carotid artery. May 29, the left eye showed slight proptosis and pulsation, ceasing when right common carotid was compressed.

Examination (June 1).—Same findings as above. Intra-ocular tension increased. Ophthalmoscope showed veins dilated to twice normal size, arteries normal. Total ophthalmoplegia. Vision of left eye was 5/12. Wassermann reaction was negative.

Operation.—Dr. Theodore Rovsing. Ligation of right common carotid. Immediate subsidence of objective symptoms. Discharged July 1, 1911. Recovered quickly, and now can read fingers at a metre's distance, but only on the temporal side. No headache. Nevertheless, she feels a continual buzzing in the left ear, but this is checked by pressure on left common carotid.

LII. SILVAN: Boy, aged sixteen, sent to specialist for a disturbance of right eye. October 20, 1913, while building a narrow bridge, he was thrown out from the bridge, against right side of head and neck, the left side of his head struck against a loaded wheelbarrow. Unconscious, and remained comatose for an entire week. Immediately after trauma, hemorrhage from nose, ears and mouth, and successively delirium, vomiting, without any general or circumconvulsive phenomena. At return of consciousness remembered nothing of accident, but psychic activity returned shortly, with no disturbance of speech or general motility or sensibility. From the beginning he noticed a painful continuous blowing and rumbling noise in head, more accentuated to the left in neighborhood of ear, like a jet of steam, with rhythmical accentuation with the radial pulse. This bruit was lessened without disappearing entirely, with little variation in time, when pressure was applied to carotid area. At the same time patient and family noticed that the right eye was more bulging, and more inflamed than the other, and that pressure above this gave distinct pulsation with systole, and stopped the subjective systolic bruit. Facial paralysis of left side from beginning. A month after injury the vision of right eye began to fail. All the ocular muscles were intact; besides exophthalmos there was chemosis to a marked degree. Patient said the visual disturbance began with slight degree of pain, with the impression of confusion of near objects, without diplopia, or abnormal sensations nor painful phenomena of any kind. This progressed gradually and became worse, and at the end of four months after accident vision was reduced to light perception.

Examination.—No visceral lesions. Healthy. Reflexes normal, intelligence and memory normal, motor and sensory perceptions normal. No headache or dizziness. No disturbance of walking or equilibrium. Exophthalmos directly forward. Tension slightly increased. Injection of bulbar and ocular conjunctiva, without chemosis or dilation of varicose veins. Upper lid slightly succulent and thick. Cornea not opaque. Pupil dilated and did not react to light or accommodation. Examination of fundus showed papilla inflamed greatly, edges sharply defined. Central vein of retina congested, turgid and tortuous. No hemorrhages. Vision was reduced to simple perception of light. Globe movable upward and downward, and outward, but paralysis of internal rectus. Pressure on the globe only moderately reduced the protrusion, and produced an acute sensation of pain, and a light thrill was noticed synchronous with carotid pulse, which corresponded with the bruit, accentuated with each pulse-beat, resembling blowing off of steam, incessant and disturbing, felt in skull, in temporo-auricular region. Stethoscope over whole skull, but especially over orbit, heard a bruit, soft, blowing, systolic accentuation slightly rough. This was

heard along the course of the great vessels along the right side of neck. Heart normal. The bruit, both subjective and objective, the thrill simultaneous with pulsation of the ocular globe when depressed, disappeared immediately and completely with compression of right common carotid, but was unaffected by pressure on left. Vision: Right, ½, field of vision normally limited; left, normal. Olfactory nerve intact. Trigeminal normal. Vision, left paralyzed in all its branches. Ptosis. Eye closed. Palate (soft) half paralyzed and deviated. Other nerves normal.

April 28, Prof. Giordano ligated common carotid just below bifurcation. During the operation one could clearly demonstrate the stopping of the thrill and pulsation of ocular globe when it was depressed. The patient on recovery felt no longer the rumbling and whistling in the skull, and by the evening of same day said that he could distinguish neighboring objects in a confused and uncertain way, which a week before he could not possibly discern. Vision progressed normally and rapidly, so that within one week from the operation the patient said that he could distinguish clearly objects near and far with precision, as before accident.

Examination (May 18).—Showed O. D. V., $^{2}/_{3}$, emm. O. S. V., $^{2}/_{3}$, field of vision normal in both. Slight ptosis. Exophthalmos noticeably reduced. Conjunctival veins less injected. Eye could be pushed back without thrill or pain. Pupil moderately dilated and reacting well. Papilla less congested. Retinal veins less tortuous and injected than before. Shining white spots with circinate arrangement near the papilla and macula, resembling the spots of albuminuric retinitis. Bruit and whistling in pre-orbital region disappeared shortly and definitely. Muscular exercise produced a very slight bruit over carotid region, not affected by posture of head, not subjectively noticed.

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OPERATION FOR REMOVING THE GALL-BLADDER*

By John B. Deaver, M.D.

of Philadelphia

surgeon-in-chief to the german hospital

The type of operation performed in the German Hospital Clinic for the removal of the gall-bladder, and which I believe is as simple as any, enabling one to explore the common duct throughout its entirety with ease and at the same time to control the bleeding from the gall-bladder bed, is the following:

With the abdomen open, the gall-bladder and the right free border of the gastrohepatic omentum freed of adhesions (not that there are adhesions in all cases), this region is thoroughly walled off, when with retractors the assistant keeps the wound wide open. The edge of the liver and the fundus of the gall-bladder are grasped with the left hand carrying a piece of moist gauze, pulled downward, outward and upward, which makes taut the cystic duct and the free border of the gastrohepatic omentum (Fig. 1).

When the liver is adherent to the parietal peritoneum to the degree that it would not be wise to attempt severing the adhesions, it will not be possible to dislocate the liver in the above manner. In the presence of a diverticulum (a dilatation of the gall-bladder at its junction with the cystic duct, sometimes called the pelvis), the diverticulum conceals the upper portion of the gastrohepatic omentum and is frequently adherent to it. In either of the above conditions the cystic duct and the free border of the gastrohepatic omentum, between the layers of which lies the duct, are made prominent by grasping either the gall-bladder low down or the diverticulum with a long pair of curved forceps and making traction (Fig. 2).

Where the diverticulum is adherent to the free border of the gastrohepatic omentum it must be freed before effective traction can be made upon the cystic duct. Unless this be carefully done the common duct may be injured, as occurred in one of the writer's cases. A small incision is made through the upper part of the free border of the gastrohepatic omentum and the cystic duct exposed (Fig. 3). The cystic duct at its junction with the gall-bladder is clamped with a long pair of hæmostatic forceps and cut across distal to the forceps with the

* Read before the College of Physicians, Philadelphia, January 5, 1916.

actual cautery (Fig. 4). A small piece of gauze is placed beneath the border of the gastrohepatic omentum to take up the bile that escapes when the cystic duct is divided (Fig. 5). A small, followed by a larger, probe is passed into the stump of the open cystic duct and carried through the common duct into the duodenum (Fig. 6), in this wise determining whether the duct and the papilla of Vater are patulous. Before the probe is withdrawn from the common duct, the duct is palpated by grasping the descending duodenum and head of the pancreas between the fingers and thumb of the free hand, when it is definitely settled whether the common duct contains a stone or stones. Further, by this means, if the duct contains a stone which is not detected by the probe and yet the probe has passed into the duodenum, through the wall of which the end of the probe can be felt, the stone will be palpated and it can also be determined if there be obstruction outside of the duct. Next, the cystic artery, lying above and to the inner side of the cystic duct, is clamped and cut. In a small percentage of cases the cystic artery lies below and to the outer side of the cystic duct. If it is not necessary to drain the common duct through the stump of the cystic, the cystic duct is ligated and next the cystic artery (Figs. 7 and 8).

The next step is the separation of the gall-bladder from the liver. This dissection is made from below upward, the gall-bladder is freed and turned upward and outward and the gall-bladder bed closed by carrying a continuous catgut suture through the liver substance forming the sides and floor of the gall-bladder bed (Fig. 9). The free end of the suture is left long and tied to the portion of the suture the needle carries through the liver substance. The tie is made on the upper side of the line of apposition of the walls of the gall-bladder bed. It will be seen that as the gall-bladder is removed step by step the suture is passed and tied so that when the gall-bladder is entirely removed the gall-bladder bed is completely closed; by this means the procedure is made a bloodless one (Fig. 10). I regard this far preferable to packing the gall-bladder bed with gauze or placing a cigarette drain therein and retaining it by suture. In a small percentage of cases where the walls of the gall-bladder are not extensively infiltrated, it will suffice to incise the serosa in the long axis of the organ upon either side sufficiently far from where it is attached to the liver to cover the gall-bladder bed when the edges are apposed by a continuous catgut suture. The lateral flaps of the serosa are reflected and the gall-bladder removed from below upward, leaving enough of the fibrous coat so as not to trespass upon the liver. There are a few instances when a gall-bladder can, to better

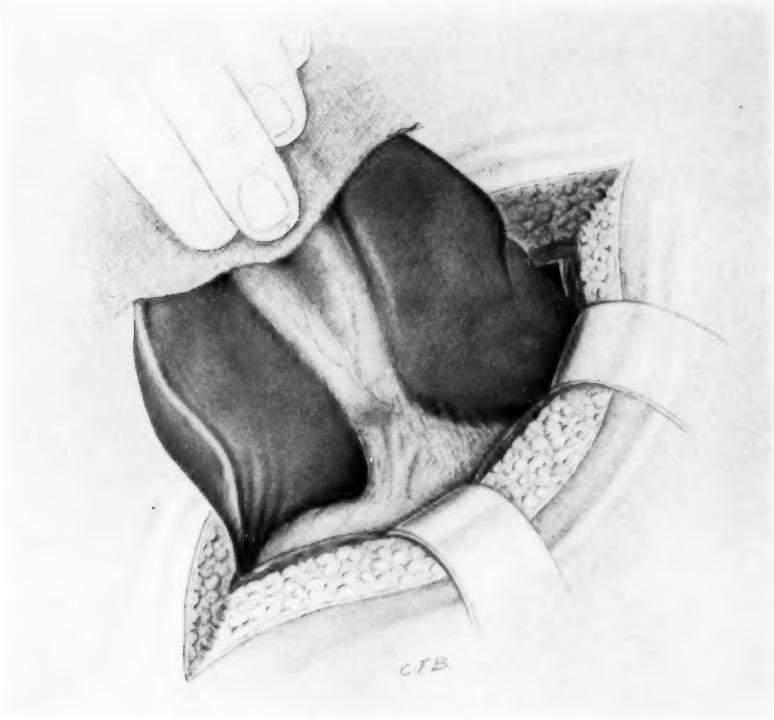

FIG. 1.—Liver dislocated, gall-bladder exposed.

FIG. 2.—Hæmostatic forceps grasping infundibulum of gall-bladder, right free border of gastrohepatic omentum with cystic duct made taut.

FIG. 3.—Cystic duct exposed, hæmostatic forceps in position.

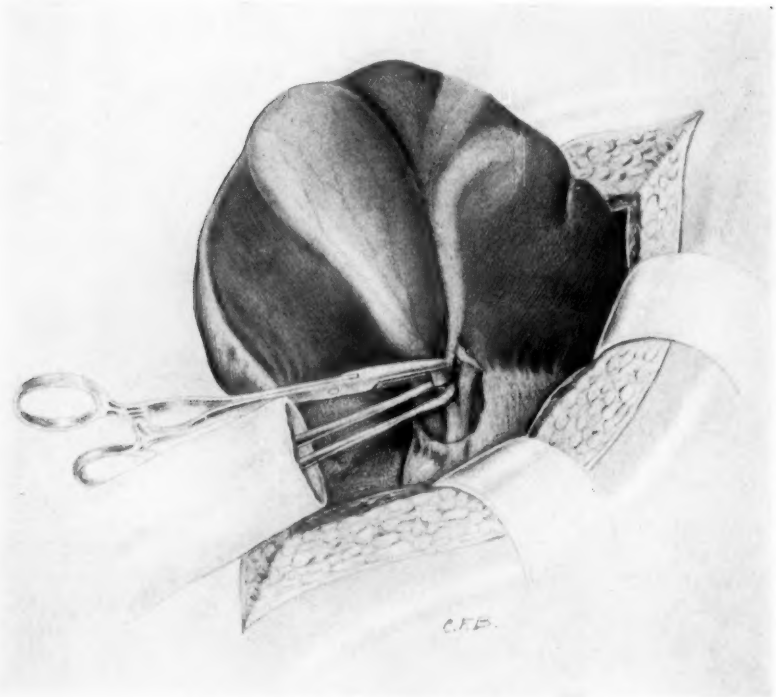

FIG. 4.—Cystic duct divided with cautery.

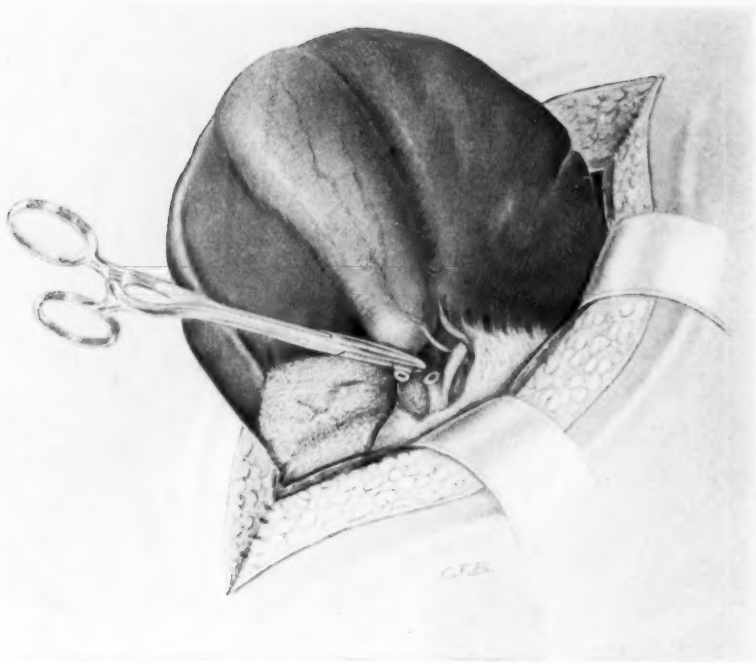

FIG. 5.—Orifice of cystic duct, cystic artery and hepatic duct exposed.

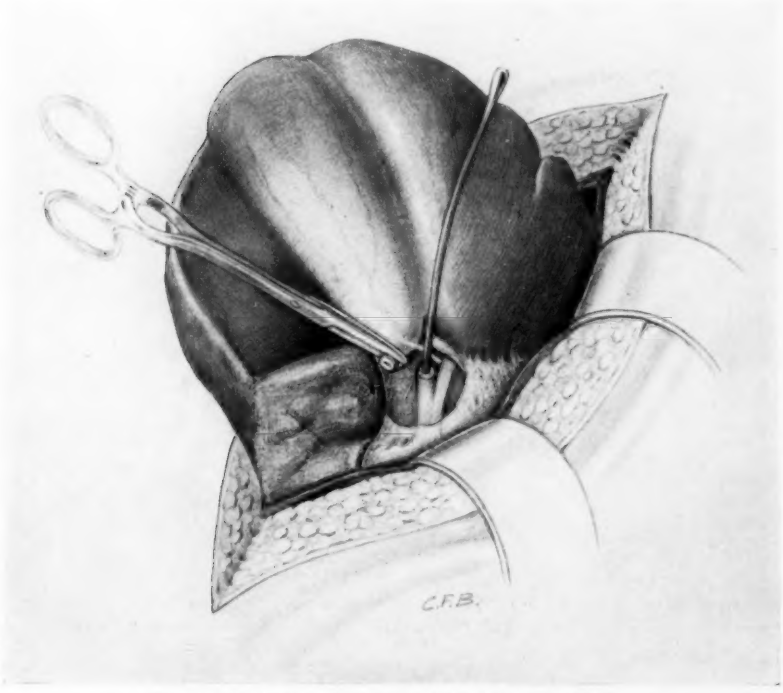

FIG. 6.—Probe introduced into orifice of cystic duct.

FIG. 7.—Cystic duct divided, hæmostatic forceps upon neck of gall-bladder and orifice of cystic duct exposed.

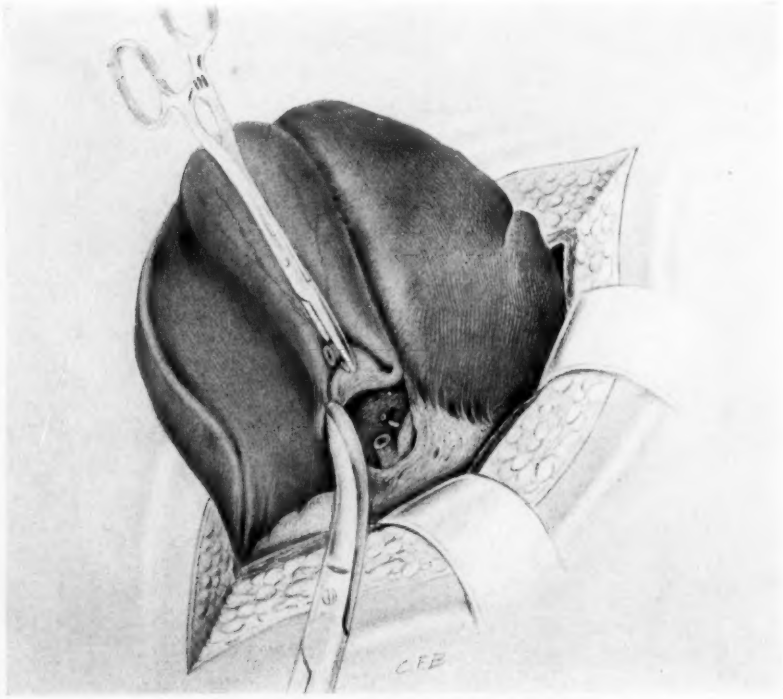

FIG. 8.—Removal of gall-bladder, cystic duct and artery ligated.

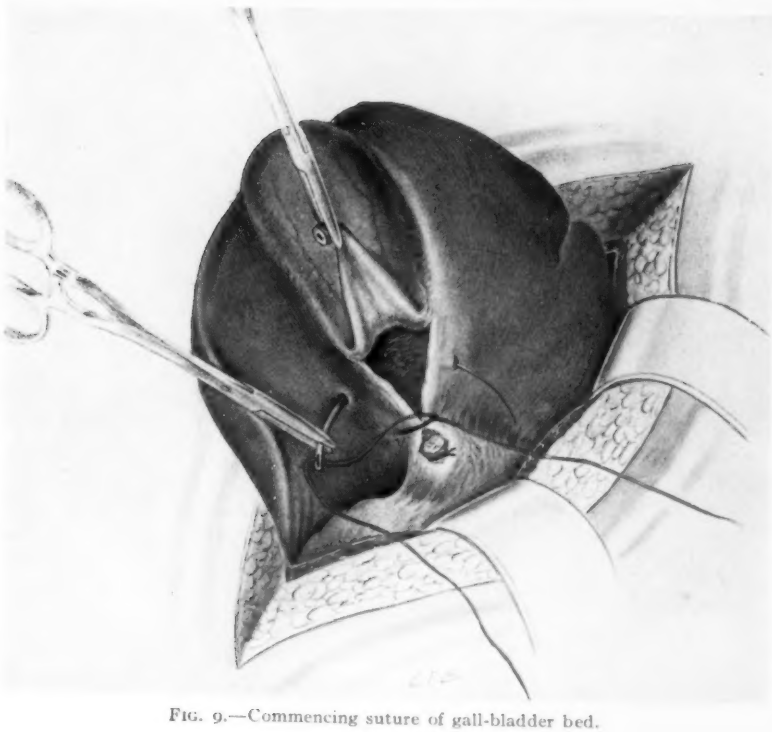

FIG. 9.—Commencing suture of gall-bladder bed.

FIG. 10.—Gall-bladder bed sutured.

advantage and with greater safety, be removed from above downward, commencing the dissection at the fundus.

The next step is suturing the divided layers of the gastrohepatic omentum, but not covering in the stump of the cystic duct. The final step is the placing of a small rubber tube down to and just beyond the free border of the gastrohepatic omentum, which is retained for four or five days, so that in the event of the ligature on the cystic duct giving way the bile will have an exit. Occasionally a glass tube is used, when it is replaced the following day by a rubber tube, the latter being small enough to be carried down the glass tube and the glass tube withdrawn. When the gall-bladder is so large that access to the cystic duct is difficult, it may be aspirated or opened and emptied, care being taken to guard against infecting the field of operation, when the removal, as above described, can be made. In some cases of gangrenous and phlegmonous gall-bladders the operation is made a little more difficult than in ordinary cases, yet this technic can be carried out.

Drainage of the common duct by way of the stump of the cystic duct is only a temporary procedure. When, as is frequently the case, it is necessary to have prolonged drainage of the common duct, I open the common duct and introduce a T-shaped rubber drainage tube. Dr. Riesman and I have one patient who is wearing such a tube now going on three years. I have a number of patients wearing these tubes. This form of drainage is introduced in certain cases of pancreatic lymphangeitis, chronic interstitial and interacinar pancreatitis.

In passing, I beg to say that early drainage of the common duct by this method or by a cholecystoduodenostomy is the only chance for the cure of pancreatic diabetes. Metabolic studies will never cure pancreatic diabetes, only the early use of the aseptic scalpel and establishing drainage before the infection has caused a serious pancreatic lymphangeitis, a forerunner of chronic pancreatitis, and this in turn of pancreatic diabetes.

ACUTE OPERATIVE DILATATION OF THE STOMACH*

REPORT OF A FATAL CASE AT THE TERMINATION OF GASTRO-ENTEROSTOMY FOR CHRONIC DUODENAL ULCER: FIVE ADDITIONAL CASES OF OPERATIVE DILATATION COLLECTED FROM THE LITERATURE: A SPECIAL STUDY OF THE ETIOLOGY OF ACUTE OPERATIVE AND POST-OPERATIVE GASTRIC DILATATION

By Burton J. Lee, M.D.

of New York

Associate Surgeon, First Surgical Division, New York Hospital

At the December meeting of this Society * the writer reported an unusual and fatal case of acute gastric dilatation, superimposed upon a chronic dilatation of the stomach. The patient died upon the table at the termination of the operation and the author felt that the whole subject of acute operative and post-operative gastrectasis was worthy of more complete study than could be covered in a simple case report.

The general subject of acute dilatation of the stomach has long been recognized as a definite clinical entity. Miller and Humby in 1853 reported a fatal case of unusual distention of the stomach, the autopsy showing contracted small intestines with no evidence of malignant disease. Bennett, in 1856, and Wilks [1] in the following year made reports of cases. Brinton, in 1859, gave a comprehensive description of the disease and included some interesting post-mortem findings. It is evident that he recognized the malady and appreciated its serious aspects. Speaking of dilatation of the stomach, he said: "On the one hand, it is incidental to various gastric maladies; on the other hand, it is occasionally the symptom (or rather the expression) of a mysterious and fatal disease which is chiefly and exclusively concerned with the stomach."

Fagge, in 1873, gave the first adequate discussion of the subject in English. He described the clinical symptoms at length and advised lavage as the only efficient treatment. His work was far-reaching and from that time on reports of similar cases may be found in the literature at frequent intervals. In 1891 Kundrat made a report of three fatal cases of intestinal obstruction, the autopsy showing a very marked dilatation of the stomach and duodenum. He attributed the cause of the distention of the organs to an obstruction of the duodenum. Riedel, in 1892, was one of the first to point out that acute dilatation of the stomach could follow an operative procedure. Schnitzler, in 1895,

* Read before the New York Surgical Society, March 8, 1916.

[1] Quoted by Fagge.

emphasized the mechanical obstruction of the duodenum as a cause of gastric dilatation and suggested the so-called postural treatment to obviate the difficulty. In 1899 Albrecht considered particularly the relationship between arteriomesenteric duodenal occlusion and gastric dilatation.

Thompson later contributed considerable clinical data, and in 1907 Conner made the whole matter the subject of critical study. His article called attention in this country to the condition, and since that time acute dilatation of the stomach has been more frequently recognized. Later contributors have been Laffer, Smith, Chavannaz, Müller and Payer, the last named covering the literature up to the year 1910. The latest papers in English were by Borchgrevink and Ruth, in 1913. In the following year Linke made a critical analysis of the condition.

The entire subject is so extensive that it seems wise to concentrate attention on certain limited phases of it. Diagnosis, treatment and also the general topic of non-surgical acute dilatation will not be considered. This report is a study of one personal case of acute operative dilatation of the stomach and of five similar cases, collected from the literature. In the discussion it is proposed to deal particularly with the pathogenesis of acute operative and post-operative stomach dilatation.

Acute Operative Dilatation of the Stomach.—Smith, in 1909, stated that the earliest recorded case of acute post-operative dilatation developed twenty hours after surgical intervention. Many writers believe, however, that a much shorter interval may elapse between the operation and the appearance of the dilatation. After making a careful examination of the gastric conditions in 300 cases under general anæsthesia, Payer was able to determine a distinct atony and dilatation of the stomach in nearly all the patients immediately after awakening from the narcosis. This paresis subsided, as a rule, in twelve or fourteen days. In cases where it persisted a grave clinical picture of acute dilatation of the stomach developed. Barker, Mathieu and also Ruth have pointed out that acute dilatation of the stomach might occur during operation and prove rapidly fatal.

Mason and Evans reported a case (No. 5) with persistent vomiting, following operation. The symptoms began upon awakening from the anæsthesia and were continuous with those of acute dilatation. Rhodes was evidently so impressed with the early onset of symptoms of acute dilatation in operative cases, that he advised lavage in every patient, either upon the operating table or immediately upon their return to the ward. Hendon states definitely that in many cases certain symptoms may be present for twenty-four hours before the vomiting of acute dilatation ap-

pears. These facts suggest that many instances of acute gastric dilatation reported as occurring during the early post-operative days are cases which have been suffering from mild progressive symptoms from the time of operation or from a period shortly following it. Attention is especially called, therefore, to the possibilities of an acute dilatation of the stomach occurring during operation, with the submission of the following six cases.

CASE I.—*Acute operative dilatation of the stomach following perineorrhaphy.* Reported by E. L. Moorehead, 1909. Mrs. Q., aged twenty-two years. Perineorrhaphy, double salpingo-oöphorectomy and appendectomy performed under ether anæsthesia, preceded by hypodermic injection of morphine sulphate gr. ¼ and atropine sulphate gr. 1/120. As the perineorrhaphy was finished, a swelling suddenly appeared within the abdomen, extending downward to the midpoint between the umbilicus and pubis. The pulse and respiration were unchanged. Laparotomy was then performed and a dilatation of the stomach was found. A stomach tube was inserted through the œsophagus and there was a gradual subsidence of the swelling with a discharge of considerable odorless gas. By lavage the water returned practically clear. The abdominal portion of the operation was then completed. Following the operation there were symptoms of gastric dilatation for about two days. The patient recovered.

CASE II.—*Acute operative dilatation of the stomach during suture of a perforating duodenal ulcer.* Reported by W. G. Richardson, 1913. Male, aged forty-seven years. Perforation of a chronic duodenal ulcer, situated about one-half inch from the pylorus. Operation was performed seven hours after perforation. The stomach was empty and a small duodenal perforation readily found. The operation was uncomplicated and the ulcer was closed with the usual purse-string suture. The anæsthesia was a difficult one, for the man was an alcoholic. Chloroform was at first administered and following this ether, the open method being used throughout the operation. The man's color was poor during the entire anæsthesia and his breathing abnormal. Most of the time his pupils were widely dilated. During the suturing of the wound, there was a rapid distention of the stomach and its veins were considerably engorged. No dilatation of the duodenum was noted and there was no distention of the lower abdomen. A stomach tube was passed and a quantity of gas, under tension, was evacuated. The stomach rapidly contracted and the operation was then completed, the patient making a normal recovery.

CASE III.—*Acute operative dilatation of the stomach associated with double salpingectomy.* Reported by A. Mayoral, 1915. Female, aged twenty-one years, double suppurative salpingitis. Dilatation and curettage performed; patient then placed in the Trendelenburg position and a median laparotomy was done. Both tubes were the seat of an inflammatory process and there was a certain amount of pelvic inflammation. The operator had removed the right tube, and as he was about to amputate the left, "the patient began to act queerly, the respiration quickened, the pulse became rapid and thready and the intestines came out of the wound and were held back with difficulty. I continued the operation as well as I could, and in placing my hand in the wound was surprised to find the stomach at the upper edge of the incision, and a second later almost

three fingers' breadths from the symphysis pubis." A stomach tube allowed the escape of a good quantity of gas, but there was no exit of fluid. The anæsthesia was a difficult one and deeper narcosis was frequently asked for, the patient being rigid throughout the operation. Complete relaxation was obtained only a short time before the appearance of the dilated stomach. The patient's recovery was uneventful.

CASES IV AND V.—*Acute operative dilatation of the stomach, associated respectively with appendectomy and posterior gastro-enterostomy for gastric ulcer.* Reported by W. H. Luckett, 1915. In each instance the dilatation of the stomach was definitely visible and the operator was able to verify by palpation the rapid distention of the organ. In neither case had the patient been under anæsthesia longer than fifteen minutes when the dilatation occurred. The stomach tube was passed in both cases, the upper end being immersed in water. There was an escape of gas, but no fluid material, with rapid relief of the symptoms. The surgeon believed that the dilatation in both instances was due to a swallowing of air during the operation, and thought that he had observed this swallowing act before the gastric distention occurred.

CASE VI.—*Acute operative dilatation of the stomach, superimposed upon chronic dilatation with pyloric stenosis. Perforating ulcer of the duodenum; posterior gastro-enterostomy; death upon the operating table; autopsy.* Male, aged 31 years; a longshoreman; Peruvian. Family and personal history negative. Had syphilis ten years before admission, but received little treatment. No history of cough, but recently he developed night-sweats. Never any dyspepsia or loss of appetite. Five years before admission he began to suffer from slight pain in his epigastrium, when his stomach was empty. No vomiting was present nor any other symptom save the pain, which continued for about two years. No previous operation. Seven months before admission he had a severe attack of pain in the abdomen and soon felt very sick. He had a large hemorrhage from the bowels and fainted a moment later. There was no vomiting, but for several days blood continued in the fæces. About a month before admission he began to have epigastric pain, coming on two or three hours after meals, which was relieved by eructation of gas. For the three days prior to entering the hospital, vomiting was frequent. The vomitus included food taken thirty hours before, and some black material, but no blood. He had lost sixty-seven pounds in the last seven months.

Physical Examination.—Some loss of flesh and moderate anæmia. Mouth, teeth and pharynx negative; tongue slightly coated. Moderate general enlargement of lymph-nodes. Chest normal save for slight changes in percussion note. Heart and arteries normal. The abdomen was soft and tympanitic, but there was no tenderness, rigidity or masses. The liver percussed nor-

mal. Further examination showed nothing of any importance.

Laboratory Examinations.—The string test for blood in the duodenum was positive. The report on the fasting contents of the stomach showed 170 c.c. of dark brown viscid fluid, one-half being food remnants; no mucus; guaiac, ++; free HCl, 37; total acidity, 67; combined acidity, 24; microscopic examination, no red blood-cells. Ewald test-meal showed: 170 c.c. of dark brown fluid, with one-quarter food remnants; mucus, slight amount; guaiac, +; free HCl, 33; total HCl, 66; combined HCl, 26; microscopic examination, food remnants, but no red blood-cells. Blood in stools positive by guaiac test. Urine was negative and the daily amount was 1000 to 1600 c.c.

Radiographic Examination (by Dr. Busby).—" A suspicion of carcinoma about the pylorus and some gastroptosis. The six and twenty-four hour meals show considerable retention."

Diagnosis.—Duodenal ulcer with pyloroplasm, neoplasm not excluded.

Operation.—Anæsthesia—gas and ether. Posterior no-loop gastro-enterostomy. A six-inch midline incision above the umbilicus; the pylorus just admitting the tip of the finger. Lying behind and below the pylorus, adjacent to the first part of the duodenum, was an indurated mass about two inches in diameter, believed to be an ulcer. Excision seemed so difficult that a no-loop posterior gastro-enterostomy was done. The gastrocolic omentum was tacked up to the stomach in the usual way. As the closure of the abdomen was begun, the intestines began to be pushed out through the abdominal wound, suggesting that the patient was coming out of the anæsthesia. More ether was requested by the surgeon. Because of this bulging of a portion of the abdominal viscera, the closing of the peritoneum was attended with some difficulty. No suspicion was entertained at this moment that an acute dilatation of the stomach was the cause of the intestinal protrusion and time was taken to close the abdomen with tier sutures. As the final skin stitches were being placed, it became apparent that the patient was in a desperate condition, and he was dead a moment later. Artificial respiration was performed for ten minutes and an effort was made to massage the heart through the abdominal wound, which had been hastily reopened. Time of operation, one hour and thirty minutes.

Autopsy (by W. Elser).—Examination made 48 hours after death.

Summary.—Diagnosis: Stenosis of pyloric orifice; chronic dilatation of stomach with acute dilatation superimposed; ulcer of duodenum (perforating); œdema of the lungs; chronic pulmonary tuberculosis.

The positive findings follow: Rather anæmic subject. Abdomen distended and rather tense. *Heart:* A trifle smaller than normal; weight, 9 ounces. *Aorta:* The entire vessel was relatively small, considering the size of the individual. *Coronaries:* Smaller than usual. *Pleuræ and Lungs:* High grade of pulmonary œdema and congestion of right lung, especially at base; similar, but less marked, findings in left lung. Firm pleural adhesions at both apices, with numerous tuberculous foci at left apex. "*Stomach* is enormously dilated and partially filled with a grey, thin fluid material and gas. When moderately distended with water the stomach measures 17 inches by 10 inches by 7 inches.[2] On the posterior aspect of the stomach, about 4 inches from the pylorus, an anastomosis between the stomach and the jejunum has been made. The duodenum is markedly dilated. The marked distention of the duodenum comes to a sudden stop at the point where the mesentery crosses the gut.[3]

"Dissection of the stomach and duodenum in the hardened state reveals the following somewhat remarkable conditions. The pyloric orifice viewed from the stomach side appears as an opening irregularly circular in outline and measuring a trifle less than 5 mm. across. The lip of this opening consists of puckered, greyish-yellow mucous membrane. Viewed from the duodenal side an irregularly circular opening measuring 7 by 10 mm. is found. The lower part of the margin is denuded of mucous membrane. Situated below and between these openings, which evidently represent the terminals of the pyloric channel, is a cavity about the size of a pigeon's egg, presenting an irregular surface. A probe passed through what appears to be the pyloric channel traverses the upper end of this cavity; in other words, the floor of the pyloric channel is wanting. The cavity proper extends beneath the greater curvature of the stomach, encroaching upon the pancreas. It does not extend, however, to the duodenum itself. Between the inner surface of the cavity facing the duodenum and the duodenum proper, a triangular portion of the pancreas, measuring at its base 2 cm., is interposed."

Microscopical examination of the walls of the duodenal ulcer showed the usual picture of a benign ulcer of long standing. A microscopical examination of the stomach wall showed marked

[2] See photograph of the organ *in situ*, and of the organ in the hardened condition.

[3] The stomach, duodenum and a portion of the jejunum were filled with formaldehyde and preserved for museum purposes.

thinning of the mucosa and musculature, due to distention of the organ.

Remainder of small intestine moderately distended with fluid material; mucosa œdematous. Large intestine, particularly the transverse colon, distended with gas; mucosa œdematous. Mesenteric lymph-nodes moderately swollen.

"The marked dilatation of the stomach, including the duodenum, and the close similarity of the findings in this case with those noted in other uncomplicated cases of acute dilatation of the stomach, leaves, in our opinion, little doubt concerning the correctness of the diagnosis in this case. Concerning the exact cause of death, absolute certainty is not attainable."

From a consideration of the preceding data, it is apparent that acute operative dilatation of the stomach is not of infrequent occurrence. Case VI contains, however, some factors of uncertainty as to the propriety of including it with the other examples of acute operative dilatation, and demands special attention. Concerning the degree of chronic dilatation existing prior to operation, the X-ray pictures show a large stomach, and the partial obstruction of the pylorus offers an explanation of this condition. Moreover, the pictures do not reveal an organ at all comparable in size with the one found at autopsy. Furthermore, observation during the operation did not indicate that the stomach was of such size as was found by the pathologist. Finally, the protrusion of intestinal coils, near the end of the operation, was an unusual occurrence calling for comment at that time. It is reasonable, therefore, to regard this case as an acute operative dilatation.

At this point it seems proper to consider the factors which may have determined this man's death. Aside from the possible influence of a rather prolonged anæsthesia, producing, or helping to produce, the acute dilatation of the stomach, the general toxicity of the anæsthesia must also be borne in mind. A second element to be considered is the hypoplasia of the vascular system, which certainly may have had some relation to the man's vulnerability. Without other evidences of status lymphaticus, it seems justifiable to decide that this condition of hypoplasia was not a factor in the fatal termination. Pulmonary and coronary embolism were excluded at autopsy. Œdema of the lungs may not be dismissed. The absolute cause of death cannot be determined with certainty, but the clinical and pathological observations lead to the conviction that the acute dilatation of the stomach was an important factor.

Numerous theories have been advanced to explain the pathogenesis of acute dilatation of the stomach. Many writers suggest that indi-

vidual predisposition may have some influence. In support of this theory, Payer, Chavannaz, Pignacca and Linke cite instances of acute dilatation of the stomach in successive operations upon the same patient. Individual predisposition is so indefinite that it seems impossible to discuss it intelligently. A differentiation should be made, however, between so-called predisposition and certain predisposing factors, which may be regarded as favoring the development of acute dilatation. Such conditions as gastroptosis, enteroptosis, hyperchlorhydria, and various forms of digestive and nervous disturbances have been occasionally assigned as predisposing causes.

Riedel's theory of serous infiltration of the stomach wall, with subsequent dilatation, is not confirmed by other observers. Arcangeli's [4] hypothesis attributes the gastric dilatation to secretory insufficiency of the adrenal glands, and Kuru believes that lesions of the chromaffin system occasionally play an important part in the paresis of the stomach.

On the other hand, Albrecht, Müller, Nicholls, von Haberer and others support the belief that arteriomesenteric occlusion of the duodenum is the primary factor in the acute dilatation of the stomach. Albrecht showed that normally, at the mesenteric crossing of the duodenum, there is a slight physiological obstruction to the passage of duodenal contents. It is well known that in the normal duodenum there is a groove upon the anterior surface, where it is crossed by the superior mesenteric vessels. Conner found that duodenal obstruction by the mesentery was probably present in from one-half to one-third of all cases of acute gastric dilatation. He concluded that the pull downward upon the mesentery, by the empty small intestines hanging in the true pelvis, could produce obstruction at the lower end of the duodenum. Albrecht's experiments on the cadaver demonstrated that a weight of two kilogrammes pulling upon the mesentery was sufficient to occlude the duodenum. Pignacca and Hunter claim, however, that the mesenteric traction from this source is never more than one-half kilogramme, and therefore the weight of the intestine alone is insufficient.

Müller called attention to the similarity of symptoms in cases of high intestinal obstruction and acute gastric dilatation. He therefore inferred that the cause of the acute distention of the stomach was an arteriomesenteric obstruction of the duodenum.

The good effect of postural treatment, suggested by Schnitzler, is often advanced as an argument for primary duodenal obstruction. The relief obtained is significant only when the treatment is applied early,

[4] Quoted by Pignacca.

for then sufficient time has not elapsed to permit a stomach acutely dilated to produce secondarily a duodenal occlusion. On the other hand, most of the cases showing the good results of postural change are those with fully developed symptoms.

There is much evidence which does not favor the theory of primary occlusion of the duodenum. A chronic dilatation of the stomach may be a predisposing cause of duodenal obstruction, either through pressure upon the duodenum or forcing intestinal contents downward, with a drag upon the mesentery. On the other hand, it is apparent that an atonic, dilated stomach favors the development of acute dilatation from the weakened condition of the gastric wall. The presence of a gastro-enterostomy in a case of chronic dilatation with subsequent acute distention seems to dispose of duodenal occlusion as a primary causative factor in these cases and a very considerable number of such instances is cited.

Psaltoff's case, with many others, illustrates the not infrequent finding of the enlarged stomach without any dilatation of the duodenum or evidence of obstruction anywhere throughout the duodenum. Surely in these cases there is no question whatever concerning the non-existence of any primary occlusion of the duodenum, but it is certain that the distention of the stomach is the initial lesion.

Hunter and also Thomson argue against primary duodenal occlusion in cases of acute gastric dilatation in which the intestines are often dilated below the duodenum and therefore below the point for arterio-mesenteric duodenal obstruction. It is apparent here that an occlusion of the duodenum at the mesenteric crossing cannot account for all the dilated intestine found.

The good results obtained in the vast number of cases of acute gastric dilatation by repeated lavage is difficult to explain if the obstruction of the duodenum by the mesentery is really the initial factor. It is difficult to believe that lavage could do any great amount of good to an obstructed duodenum save secondarily, by diminishing the size of the stomach.

In Cases I to V, of this report, the operators actually saw the stomach dilating and, in two instances, the patients had been under the anæsthetic but fifteen minutes. One cannot imagine a mesenteric occlusion acting thus rapidly, and it is necessary to believe that the initial lesion was beginning before the eyes of the operator. It seems fair to grant, therefore, that the primary change in acute gastric dilatation does not lie in an obstruction of the duodenum, but takes place in the stomach itself.

The increasing number of those who believe that the stomach is the

primary lesion, includes: Box and Wallace, Braun and Seidel, Birnbaum, Conner, Laffer, Thomâ, Barker, Mathieu, Ruth, von Herff, and most of the recent writers. All factors entering into the dilatation may be included if we consider the orifices of the distended organ, its muscular wall and influences affecting its tonicity, and finally the gastric contents. Cannon's monograph, "The Mechanical Factors of Digestion," furnishes much valuable data upon the physiological side of the question.

The Cardiac Orifice.—It has been established that most of the time the cardia is closed. This may be demonstrated clinically by inspection and palpation through the opened stomach and by radiographic studies. The nervous impulse controlling the contraction of the cardiac orifice passes along the pneumogastric nerves, and both stimulating and inhibitory fibres are present. Adrenalin, however, which acts upon the sympathetic nervous mechanism, relaxes the cardiac orifice, proving a partial sympathetic control of the cardia.

Cannon has shown that the cardiac sphincter in normal individuals is not always closed. During the presence of food in the stomach there is a rhythmic contraction of the sphincter, with recurring regurgitations of food back into the œsophagus. The positive factors in this regurgitation are gastric contents sufficiently fluid, and a proper amount of pressure within the stomach. After a time the acid in the stomach automatically stimulates cardiac contraction, thus preventing further regurgitation. There is an experimental proof that this same influence of acid upon cardiac contraction persists in animals whose splanchnic nerves have been divided, or whose pneumogastric nerves have been severed, and also in those under anæsthesia.

One element, emphasized by Cannon, may have a bearing upon the problem of dilatation. "Although the evidence points to the acid control of the cardia, through a local reflex, we must not forget that the cardia is nevertheless under the influence of extrinsic nerves, and that in abnormal states, these nerves may cause the sphincter to relax and permit regurgitation of food that is acid."

Kelling felt that both orifices must be closed to permit the development of an acute dilatation of the stomach. He experimented on non-anæsthetized animals with a cannula inserted through the anterior gastric wall. As the intragastric pressure was increased, the animal would vomit, and it was impossible to produce an acute dilatation. On the contrary, when the animal was fully narcotized, or if the pneumogastric nerves were cut, the stomach could be distended until it burst. Braun

and Seidel agreed concerning the valvular action at the cardia. They concluded, however, that the cardiac obstruction obtained by Kelling was probably due to the work having been done through an open abdomen. In their experiments, they found that gas would regurgitate into the œsophagus when the belly was closed. Conner, after reproducing some of Kelling's experimental work, with some variation in results, emphasized that experiments upon the cadaver could not properly be used in explaining the mechanism of acute gastric dilatation.

In cases of paralytic ileus an isolated distended loop of bowel has often been found with no mechanical obstruction above or below, and a similar finding may be obtained in a narcotized animal after traumatism to the intestine. There may be some factors of analogy in the results of such an experiment and the rapid dilatation of the stomach itself in an acute dilatation, though the element of traumatism may be lacking. Smith suggests that an obstruction from paresis might reasonably explain a moderate dilatation of the stomach, without a closed cardia. A very distended organ, on the other hand, would seem impossible without a closure at the cardiac valve.

Knowledge is still incomplete concerning the part borne by acid gastric contents and the extrinsic nervous supply in maintaining the closed cardia in cases of dilatation.

The Pylorus.—It is now clearly understood that the two portions of the stomach are distinct as concerns their functions. The cardiac segment receives the food and serves as a cavity in which salivary digestion is continued. The pyloric portion, however, provides a place for an active gastric digestion. Cannon has established that the pylorus is occluded by contraction when food enters the stomach, this condition persisting for some time. At short intervals the sphincter relaxes, and small amounts of food are discharged into the duodenum. This giving way of the muscular contraction at the pyloric valve is caused by the presence of acid at the pylorus. The acid in the duodenum below the sphincter closes it and it remains closed until the flow of pancreatic and other juices neutralizes the acid. As the process of neutralization progresses, the tonicity of the pylorus is weakened and acid again accumulates on the stomach side of the valve, causing once more a relaxation. Cannon regards the " acid control of the pylorus " as " one of the remarkable automatisms of the body."

Howell has demonstrated that when the splanchnics are stimulated, the contracted stomach dilates and the pyloric sphincter relaxes. It is known that the pyloric valve, as well as the other portions of the muscular wall, receives motor fibres from the vagus nerves. Some

observers have noted contraction, others relaxation of the pyloric sphincter from stimulation of the pneumogastric. Openchowski [5] was able to cause dilatation of the cardiac opening, and a simultaneous contraction at the pylorus.

Thomson felt that pyloric closure could be put out of consideration, because frequently the duodenum is dilated also, and because the vomitus contains bile. However, a dilated duodenum is absent in many cases of acute gastric dilatation. Moreover, both the distended duodenum and the vomiting of bile may be the result of a secondary duodenal obstruction by the mesentery from the presence of a markedly dilated stomach. It appears probable, however, that, as with the cardia, a contracted pyloric sphincter is an essential element in the production of acute gastric distention. The part played by the acid control of the pylorus and by the extrinsic nervous regulation remains still undetermined.

The Gastric Musculature and Its Nervous Control.—Howell and Cannon regard the motor mechanism of the stomach as an automatic one, but subject to control by the vagus and sympathetic nerves. The stimuli to contraction are intrinsic, while the regulation is extrinsic. The extrinsic nerves are the pneumogastric and the splanchnic, the former being mostly motor, and the latter largely inhibitory. Various plexuses connected with the splanchnics are described, but no practical use has yet been made of their anatomical distribution.

The intrinsic nervous supply of the stomach resides in the plexuses of Meissner and Auerbach, comprising numerous ganglia. In a stomach removed from the body, certain peristaltic movements and some gastric digestion continue for a considerable time, if the organ be kept moist and warm. It is uncertain whether this automatic property resides within the plexuses named or in the muscle itself. Starling has shown that stimulation of the sympathetic diminishes motor activity, through a contraction of the blood-vessels supplying the viscus.

Cannon states that in the presence of unusual mental emotion or fright, gastric peristalsis ceases almost immediately. Experimentally,[6] acute dilatation of the stomach may readily be produced. When the proximal end of the pneumogastric nerve is stimulated, a reflex inhibition of the normal tone of the stomach occurs and dilatation results. The swift onset of symptoms in numerous dilatation cases suggests a rapid and profound change in the nervous mechanism of the stomach. It seems as if some shock had suddenly reached the organ, paralyzing

[5] Quoted by Cannon.
[6] Wertheimer, quoted by Howell.

its functions. A central nervous change appears more probable than one in the intrinsic supply of the organ, for dilatation occurs frequently in the presence of marked toxic symptoms.

There is a great deal of evidence pointing toward some toxic agent, influencing the nervous mechanism of the stomach, resulting in its motor paralysis, and possibly, in an overactivity of its secretory function. Further, the frequent occurrence of marked diminution, or even suppression, of urine in acute dilatation suggests the presence of some toxic substance. Acute gastric dilatation may also occur in the course of pneumonia, typhoid fever, eclampsia and other markedly toxic conditions, and a similar toxæmia may possibly be inferred in the post-operative cases. Hendon calls attention to the marked mental disturbances accompanying acute dilatation, again suggesting some toxic agent. No consideration of toxæmia in acute gastric distention would be complete without thinking of the anæsthetic itself as a possible toxic agent. Most of the acute dilatations develop with or after general anæsthesia. Whatever other toxic substances may be present, the anæsthetic itself must be regarded as a possible added factor contributing to toxæmia.

Gastric Contents.—The normal acidity of gastric juice as it is secreted is about 0.5 per cent. HCl. Boldryeff, in his contribution to the chemistry of the stomach, points out that the maintenance of the gastric acidity at a fixed level is largely accomplished by access of alkaline juices to the organ. An automatic regurgitation from the duodenum permits access to the stomach of pancreatic juice and bile. The former is the most active neutralizing agent, being the strongest alkaline secretion in the body. The latter is normally present in the stomach fluid. Other alkaline juices present are the saliva and the gastric mucus. The process of neutralization continues until the acidity of the stomach is reduced to the usual level of about 0.15 per cent. HCl.

Howell shows that the gastric secretion may be either nervous or chemical. Stimulation of the vagus causes a flow of gastric juice and a coincident pyloric contraction, illustrating the coördination of the motor and secretory functions of the stomach. The pneumogastric also carries some inhibitory fibres. Chemical secretion is induced by secretagogues or hormones from the food or digestive products. The sources of fluid in the stomach are therefore gastric secretion, regurgitation from the duodenum and food and saliva swallowed.

Little data may be found on the character of the fluid contents of the acutely dilated stomach. Unfortunately, in the author's personal case, no analysis of the fluid material was made, that the specimen might be

preserved for gross pathological purposes. Conner, however, says: "There can be no doubt that bile is present in the vomitus in most cases. In several instances, small quantities of blood could be detected in the stomach contents." In some cases, free HCl has been absent, with or without lactic acid. In an instance quoted by Conner there was a total acidity of 48, with free HCl, but no lactic acid. Mathieu proved by chemical analysis that the dark color of the fluid vomited is due to bile, thus proving definitely, in his cases, a regurgitation from the duodenum. The secretion at times is excessive, especially in the more advanced cases. Cases I to V, in this report, illustrate the absence of secretion in the initial stages of the dilatation. Friedmann explains the tremendous secretion on the basis of a stasis in the vessels of the stomach. This theory seems a reasonable surmise, but it is not a proven fact. Pilcher points out the toxicity of the fluid in the stomach and duodenum in cases with acute dilatation. Instances have been reported with a rapidly fatal result, after active catharsis. More clinical data are needed to make a satisfactory decision upon the character of the fluid within the stomach and the source from which it is derived.

It is well known that a certain amount of gas is normally present in the stomach. This gas is regurgitated when the intragastric pressure reaches a definite point, the cardia readily relaxing. The horizontal posture makes eructation of gas more difficult and may interfere considerably with peristalsis. Deep narcosis prevents the giving way of the contracted cardia, as Kelling's experiments seemed to demonstrate. The presence of gas in an acutely dilated stomach may be accounted for either by fermentation of food material in the organ, regurgitation of gas from the duodenum, swallowing of ether or excreting it into the stomach, or by air swallowing. That fermentation of food within the stomach may be a factor in gas production seems improbable, save in the cases of chronic dilatation of the stomach, especially those with some pyloric or other obstruction. On the other hand, the personal case reported possibly illustrates the exceptional example of a chronic dilatation with stenosis where fermentation of material within the stomach might have served as a partial source of gas.

The writer is unable to furnish any definite data concerning a possible regurgitation of gas from the duodenum as a cause for the distention, but believes it very improbable in the early stages of the malady.

That the source of the gas is from the excretion of the anæsthetic through the stomach mucosa seems an unreasonable explanation. The amount of anæsthetic excreted in this way could hardly be sufficient to account for some of the very rapid cases, as instance, one of this series

with acute distention of the stomach fifteen minutes after the beginning of anæsthesia. The suggestion by Gerster that the distention of the stomach may be explained by the swallowing, during anæsthesia, of a small quantity of ether, which may have vaporized within the stomach, is not borne out by clinical or other findings.

Lardennois, Mathieu, Lagarde and Buchholz have laid emphasis on aërophagia as the most important etiological cause of acute gastric dilatation. Couto goes so far as to give physical signs of an habitual aërophagic, that better recognition of the condition may be made. Tissier believes that air swallowing is practically the sole cause of the dilatation, and claims that the symptoms of acute gastrectasis correspond closely to grave cases of aërophagia. Furthermore, the same treatment is effective in both conditions. The anæsthetic, exciting the buccal glands to secrete, causes many patients to swallow at frequent intervals, carrying air with the mucus into the stomach. Several operators have observed air swallowing during the operation. The swallowing is thought to be most marked in those who are confirmed aërophagics. Smith and Le Wald have recently reported some interesting findings in infants by radiographic examination. In the prone position, fluid contents covered both orifices of the stomach, locking the gas within and giving rise to gastric distention and digestive disturbances. It seems certain that rapid dilatation must be associated with the presence of a gas as the distending force, and Cases I to V, seen at the beginning of the malady, confirm this conclusion. Surely the simplest source for the gas is air swallowing, and many proofs lacking for other theories, the writer is compelled to believe that air swallowing is a definite factor in the causation of acute operative and post-operative dilatation. Such a condition by no means excludes some additional toxic influence, acting upon the nervous mechanism with consequent paresis of the gastric wall and secretory functions.

CONCLUSIONS

1. Acute operative dilatation of the stomach is a definite clinical entity and its occurrence is not infrequent.

2. It may be observed during operation and may be the cause of immediate death.

3. Many cases of so-called acute post-operative dilatation have really begun upon the operating table or shortly after the termination of the operation.

4. The dilatation of the stomach is primary.

5. The complete etiological factors are not yet evident.

6. A simultaneous closure of the cardia and pylorus is essential to the production of an acute dilatation.

7. Such a simultaneous closure can probably not be accounted for by the acid gastric secretion, for while it closes the cardia, it relaxes the pylorus.

8. An interference with the nervous mechanism of the stomach, resulting in contracted orifices and a paretic wall, is a probable factor in many cases.

9. The frequent presence of toxic symptoms suggests a change in the central nervous mechanism.

10. The occurrence of acute operative dilatation with difficult anæsthesias suggests that the anæsthetic may exert an important influence.

11. The distending agent is gas, which appears before any accumulation of fluid.

12. The usual source of the gas is an air swallowing during anæsthesia.

13. In certain cases, the air swallowed may be the initial and major factor, with the dorsal position a secondary influence, preventing easy exit of the gas.

14. In acute dilatation, superimposed upon a chronic dilatation of the stomach, fermentation of food residue may account for the presence of some of the gas.

15. Further study is essential to solve the problems of the exact etiology of this malady. This study must be along lines of experimental physiology and physiological chemistry, rather than those of pathology.

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THE INEFFICACY OF PYLORIC EXCLUSION BY FASCIAL BANDS*

AN EXPERIMENTAL STUDY

By Harold Neuhof, M.D.
of New York City

(From the Department of Surgical Research, College of Physicians and Surgeons, Columbia University)

When it was shown that exclusion of the pylorus by the silk ligature method resulted in incomplete or too temporary closure,[1] attempts were made to occlude the pylorus by other materials. Of these, fascia offered the most promising possibilities, for it is a tissue of great resistance and remains viable, when transplanted, for a considerable period.[2] In 1908, Bogoljubow [3] reported that he had obtained, experimentally, complete occlusion of the pylorus by ligation with fascia strips. The operation was performed on the human being by Wilms [4] in 1911; subsequently by a number of other surgeons. Uniformly successful results were reported. The procedure bid fair to become the standard one for pyloric exclusion, and a difficult problem in gastric surgery appeared solved. Recently, however, a very few unsatisfactory results—*i.e.*, perigastric adhesions or patent pylorus—have been described. It thus became a question of interest to determine definitely if the experimental basis for the operation was entirely correct.

In analyzing the experimental studies that have been made, one finds that, in the work of Bogoljubow, the longest period of observation after operation was fifty days. That period was not appreciably longer in Protassoff's [5] experiments, which substantiated the findings of the originator of the method. Von Tappeiner [6] investigated the great variety of exclusions that have been advocated and found that the fascial

* Read at the December, 1915, meeting of the Surgical Section of the New York Academy of Medicine.

[1] At the present time there is no general agreement upon the desirability of complete or permanent closure, or even upon the indications for exclusion. Nevertheless, it is important to know what results may be expected after the application of any of the proposed and practised methods.

[2] The question of permanent viability is as yet unsettled, and is not considered in this paper.

[3] Bogoljubow: Arch. f. klin. Chir., 1908, vol. lxxxv.

[4] Wilms: Deut. med. Wochen., 1912, No. 3.

[5] Protassoff: Tenth Russian Medical Congress, 1910.

[6] Von Tappeiner: Bruns Beitr., 1912, vol. lxxx.

band method was the one satisfactory procedure. However, he performed only three exclusions by that method. His longest period of observation was two months. At the post-mortem examinations water escaped from the pylorus, drop by drop, in every instance. Very recently Gibson and Beekman [7] have also reported a series of experiments dealing with various methods of pyloric exclusion. They strongly favor the fascia ring method for the human being, yet in only one of their seven experiments (observations were made as long as three months after operation) was a "functionally complete" occlusion obtained; in the remaining experiments the occlusion was termed "incomplete." The authors concluded that "there was undoubtedly some stenosis, and in all probability only a small amount of stomach contents passed through, the greater part going through the gastrojejunal anastomosis."

The details of technic of the experiments I performed need not be described. It will suffice to mention the two methods employed. Either the pylorus was tightly ligated with a strip of fascia lata knotted about it, or the fascia, as a broad band, was sutured snugly about the pylorus and infolded by two or three tiers of sutures. No-loop gastroenterostomies, with large stomata, were made. Table I summarizes

TABLE I

Dog No.	Period after operation at which examination was made	Condition of pylorus
135	5 days	Opened with maximal hydrostatic pressure.
172	6 days	Water-tight.
131	1 week	Opened with considerable pressure.
157	2 weeks	Patent.
145	3 weeks	Opened with moderate pressure.
303	3 weeks	Opened with considerable pressure.
167	1 month	Patent.
118	2 months	Patent.
104	2 months	Opened with moderate pressure.
97	6 weeks	Patent.
82	3 months	Opened with slight pressure.
331	5 months	Patent.
341	5 months	Patent.

my results. Only once (Dog 172), at an examination made six days after operation, was the pylorus found completely water-tight. When the examinations were made at the end of one to three weeks it was usually found closed until the hydrostatic pressure within the stomach became high. Even in this period, however, the pylorus was found open in one experiment (Dog 157). It is of interest to note that the cause

[7] Gibson and Beekman: ANN. OF SURG., 1915, vol. lxi.

for this (partial) exclusion observed shortly after operation appeared to lie in extensive peripyloric adhesions that generally developed, rather than in the constriction made by the band. In microscopic sections the fascia was found adherent to the gastric wall, but was evidently stretched, despite its great tensile strength, by the underlying musculature.

When post-mortem examinations were made one to three months after operation the pylorus either opened with moderate hydrostatic pressure or was quite patent. In the latter instance the fascial band was incorporated with the gastric wall, but it made a palpable ring that

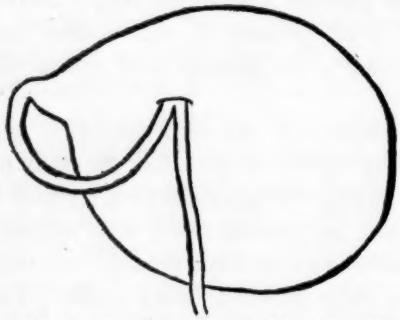

FIG. 1.—Extreme dilatation and rotation of the stomach after incomplete occlusion of the pylorus.

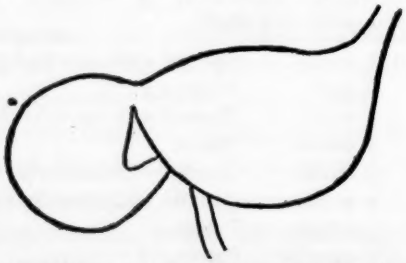

FIG. 2.—Dilatation of the duodenum after incomplete occlusion of the pylorus.

fitted loosely about the pyloric muscle. This was evident, too, in the microscopic sections. That the pylorus was widely open was certainly unquestionable at the post-mortem examinations five months after operation. In short, the error in the work of Bogoljubow and his followers was the brief period of observation after operation. Only very temporary pyloric exclusion results from ligation with fascial bands and even this cannot be expected to develop regularly.

A question that naturally arose was: Would pyloric exclusion by fascial bands be successful if the pylorus was first crushed? Several experiments were made to determine the point. In one, at the post-mortem examination two months after operation, the pylorus remained

closed with moderate, but opened with considerable, hydrostatic pressure. It was found patent, without water pressure, in the remaining experiments. Indeed, it was quite open in one of these experiments despite the fact that a large inflammatory tumor, closely surrounding the pylorus, had developed around some gauze sponges left near the stomach.

As a last effort to establish efficient pyloric exclusion with fascial strips the following operation was performed a few times: The stomach was opened near the pylorus, gauze sponges or strong tincture of iodine were vigorously rubbed into the pyloric mucous membrane, the gastric incision was closed, and the constricting fascial band then applied. These experiments were as unsuccessful as the previous ones, therefore the results need not be detailed.

Before closing, I wish to call attention to two deaths in the experimental series. They are presented because they appear to be directly ascribable to disturbed mechanical arrangements, the sequel of incomplete pyloric occlusion. Both animals were extremely emaciated and, at the post-mortem examinations, complete or almost complete retention of gastric contents was evident. In one (death one month after operation) there was enormous gastric dilatation and anterior rotation of the stomach (Fig. 1). The intestinal tract was quite empty. When the stomach was rotated backward gastric contents escaped into the duodenum through the pylorus and into the intestine at the stoma. The second animal died five months after operation. The stomach was markedly dilated, the pylorus was somewhat narrowed, and there was a tremendous dilatation of the first part of the duodenum (Fig. 2).

CONCLUSIONS

1. Experimental evidence of pyloric exclusion by fascial bands is incorrect, observations having been made too soon after operation.

2. Permanent pyloric occlusion does not follow experimental ligation with fascial bands.

3. Temporary pyloric occlusion is uncertain after experimental ligation with fascial bands.

4. Experimental pyloric occlusion by fascial bands is likewise unsuccessful after crushing the pylorus or after application of irritants to the pyloric mucosa.

5. Experimental pyloric ligation by fascial bands may be fatal, apparently from disturbed mechanical arrangements following incomplete occlusion.

6. The clinical application of pyloric exclusion by fascial bands therefore rests on an unjustifiable experimental basis.

POST-OPERATIVE INTESTINAL OBSTRUCTION*

By Charles Langdon Gibson, M.D.
of New York
SURGEON TO THE FIRST (CORNELL) DIVISION OF THE NEW YORK HOSPITAL

Intestinal obstruction as a result of operation, recent or late, furnishes us to-day with the largest number of cases requiring surgical interference. This fact is demonstrated very clearly from the operative material in my service at the New York Hospital for the last three years. Thirty-four operations have been performed for intestinal obstruction; of these, no less than 24 (70 per cent.) were due to the sequelæ of a previous operation. Seven of these cases followed directly as a complication of operation, while the patient was still in the hospital.

Post-operative intestinal obstruction is of two kinds: one directly follows and complicates an abdominal operation, the second results from the subsequent formation and persistence of adhesions due either to the performance of an operation or the existence of conditions underlying such operations. With the great increase of abdominal operations it is but quite natural, that there should be a seeming increase in the number of post-operative obstructions.

I will take up first the consideration of that form of obstruction which comes after the patient has successfully convalesced from an operation. Such cases have generally been classified under the heading of adhesions and, as it is well known, adhesions form the largest single variety of acute mechanical obstruction. The next variety of mechanical obstruction as a definite entity is intussusception, and in my studies on that subject (Intestinal Obstruction, Annals of Surgery, 1900, vol. xxxii, page 486) I found that as reported in literature these two varieties have very nearly the same frequency. There is, however, an inconsistency in these figures. Intussusception is such a clearly defined mechanical condition, so easily diagnosticated and presenting so many points of interest, that it is probably more frequently reported in literature than adhesions. To classify these post-operative obstructions as adhesions, however, does not to my mind sufficiently identify them as distinct lesions, and one object in writing this paper is to call attention to and emphasize the special importance, frequency, and gravity of this con-

*Read before the New York Surgical Society, January 12, 1916.

dition. In late obstruction the time elapsed from the previous operation was 25 days, 3 months, 4 months, 9 months, 1 year, 15 months, 2 years, 2½ years, 4 years, 6 years, 7 years, 8 years, and 21 years. In three cases the source of obstruction could be traced to the presence of an irreducible prolapse through an incisional hernia.

In a large proportion of cases the obstruction developed apparently somewhat insidiously; presumably, a chronic incomplete obstruction finally became more pronounced or complete, and we know of several instances in the series which were observed by competent practitioners at the outset but the possibilities not recognized until the symptoms were unmistakable, necessitating an operation with very small chances of recovery. If in these cases the possibilities and probability of an intestinal obstruction developing as a result of former operation had been kept in mind, the diagnosis would probably have suggested itself at a very much earlier period. It is for this reason that I would plead that a classification of the mechanical forms of acute intestinal obstruction should include these cases under a definite heading that should be as distinct as the classification of intussusception or volvulus or Meckel's diverticulum. Improvement in both diagnosis and therapy has been made in recent years but there still remains room for more. The mortality of this series is 58 per cent. for operations, both late and occurring in the convalescence; 57 per cent. for those occurring late, and 43 per cent. for those occurring in convalescence. In my paper alluded to above, I found that the mortality of operations for relief of intestinal obstruction due to adhesions was 42 per cent. This percentage is probably overfavorable, as cases collected from the literature are apt to be; whereas the cases forming the subject of this paper represent the consecutive and total material of a hospital service.

What prospects of prevention of this condition can we expect? In general terms it may be stated that the degree of perfection of technic and completeness of performing any abdominal operation will diminish the dangers of subsequent mishaps; that is, operations done with a minimum of trauma, with a minimum of raw surface, without drainage, with a complete closure of the abdominal wall and primary union should naturally give the best guarantee. It must be remembered, however, that the formation of adhesions to some degree is probably an almost necessary sequel to even the simplest and most perfect of operations. It is probable that in a considerable number of operations some slight degree of adhesions is formed at the site of operation which, however, is only temporary and disappears. It is probable that

a certain amount of temporary gluing of the omentum, less frequently of the intestine, takes place at the site of closure of the peritoneal incision. Adhesions of the most damaging nature may, however, result from the most satisfactory technic. I can remember having to operate for intestinal obstruction following the performance of an interval appendectomy with most satisfactory technic and inversion of the appendiceal stump. If the original operation has been unsatisfactory either through the necessity of drainage or of imperfect healing of the abdominal wall, it will be the part of wisdom to subject such patients, providing they are in good health and there are no serious counterindications, to a plastic repair of the abdominal wall which will effectually guarantee against the formation of subsequent herniæ. With our modern technic, it is much easier to perform such operations than formerly and, with rare exception, even the largest of these postoperative herniæ can be successfully operated upon.

I now am operating on these large herniæ (Figs. 1 and 2)[1] which formerly we used to consider inoperable by closing the opening with fascial flaps, and this procedure seems applicable and efficient to the worst forms of these herniæ. The exact description of this procedure will be the subject of a paper in the near future.

A device which I have used for some years when drainage of the abdomen is required in considerable amounts is the employment of the principle of the Mikulicz tampon by using a large piece of dental rubber dam with perforations. Into this is introduced a considerable amount of gauze packing. This gauze packing, being under a certain pressure, efficiently keeps the intestines or omentum away from the abdominal incision. In the course of a few days these structures will become fixed by adhesions and no longer tend to prolapse through the wound. When drainage is discontinued the sides of the abdominal incision may be drawn over the drained space and there will be little or no tendency for the intestine or omentum to protrude through the drainage opening (Fig. 3). In operations upon the female pelvic viscera requiring drainage, I believe it is very important if any drainage is used at all (and the cases are very few) to close the abdominal wall completely and provide for drainage through Douglas's cul-de-sac. A particularly efficient form of drainage, as after a supravaginal hysterectomy, is to split the stump posteriorly through the cervical canal to the vaginal reflection. The drainage tract is lined by mucous membrane, will not close readily and gives admirable and free drainage.

[1] I am indebted to Dr. Clay Ray Murray, House Surgeon of the New York Hospital, for making the original drawings of the illustrations for this article.

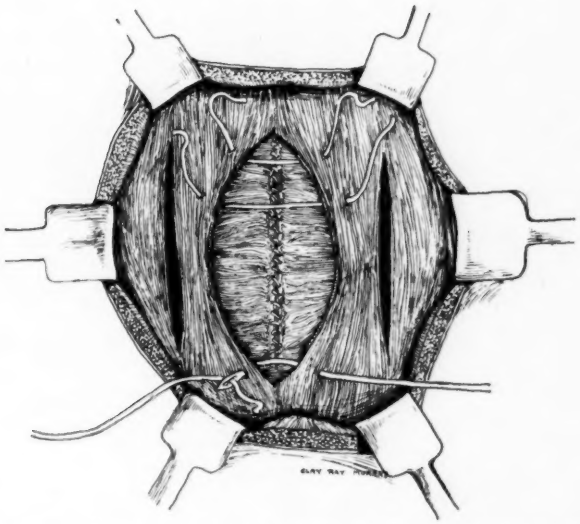

FIG. 1.—Releasing incisions in the fascia of the rectus muscle parallel to the line of suture.

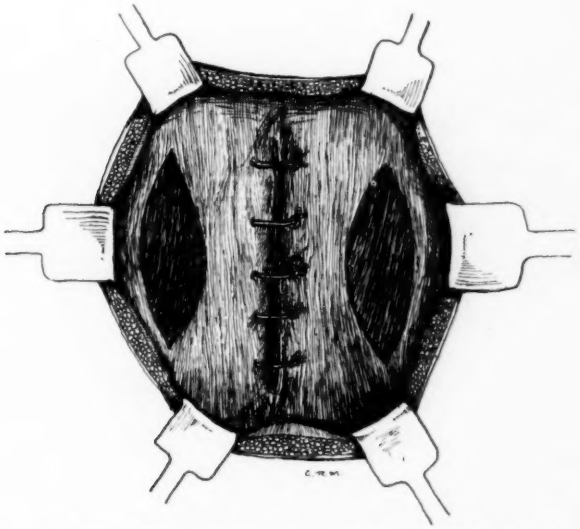

FIG. 2.—Edges of fascia reunited in midline without tension.

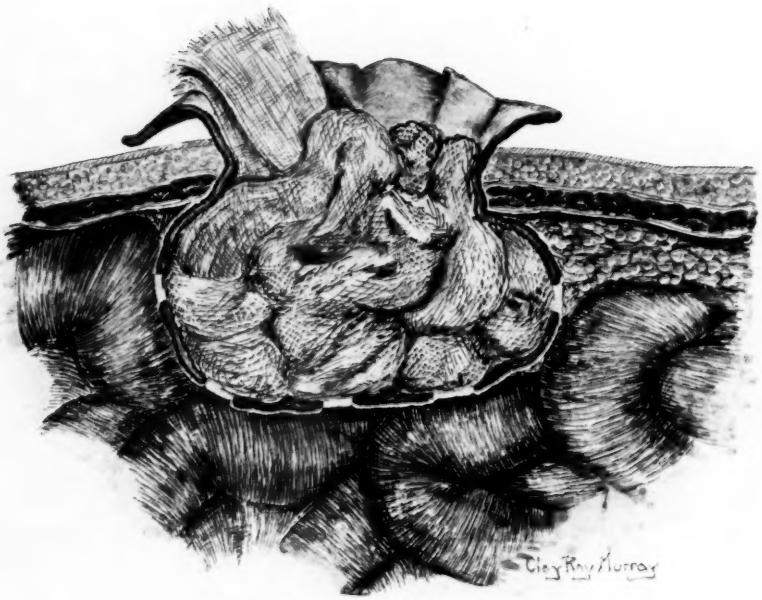

FIG. 3.—Rubber dam Mikulicz tampon.

Some of these cases of post-operative obstruction by bands offer considerable complexity as regards the extent and multiplicity of the obstructive agents. I found in my analysis (see above) that one-third of the fatal cases in obstruction by band were due to the overlooking of an unrelieved obstruction. While many of the obstructions by bands are well defined and may show injury to the vitality of the intestine requiring resection, other cases may show a diffuse matting without any one predominant strangulation or definite injury to the blood supply of the gut. In these cases, if one can feel fairly certain that the blood supply is all right, an entero-anastomosis of the loops entering and leaving the tangled area will prove to be a shorter, simpler and much safer operation. Moreover, after diversion of the fecal current, probably an improvement will take place in the conditions of the affected gut just as we see a stricture of the œsophagus relax after gastrostomy. The series of cases reported here does not contain any such operation, but on reviewing them I believe that we might have employed this procedure in some cases with betterment of our results.

Obstruction Directly Following Operation.—This form of obstruction is fairly frequent and is of two different kinds—one mechanical, the other paralytic. In many cases it is difficult or impossible to tell which variety is present.

The mechanical form is due to agglutination of the coils of intestine and omentum to each other or to the abdominal wall. A mild degree of this condition probably obtains in a large proportion of abdominal operations and, although never becoming dangerous, may be a disturbing factor in the convalescence. As I stated before, probably a considerable proportion of these agglutinations spontaneously disappear. It is my belief that these very mild forms of agglutination are easily overcome when intestinal peristalsis is reëstablished, and, therefore, as a matter of prophylaxis, I believe the securing of early peristalsis is indicated for the preventing of this as well as for the second, or paralytic, variety.

In general terms, definite mechanical obstruction by these adhesions does not ordinarily come on directly after operation, whereas the second or paralytic occurs chiefly in the course of the first few days. In a typical case of mechanical obstruction the immediate convalescence at first will probably show little or nothing to indicate what is coming; in fact, the patient may feel well, the course will be relatively afebrile, post-anæsthetic nausea and vomiting will have ceased, and a stool and flatus may have been passed. The abdominal distention, if any, will be

moderate. Suddenly, say in from five to ten days, the patient's general demeanor will change and it is obvious that his condition has become worse. The first symptom usually will be vomiting, and this vomiting will be repeated and particularly early if the obstruction is in the upper part of the intestine. Distention at first may or may not be obvious. The obstruction usually involves the small intestine, distention therefore not being as great as in obstruction lower down. This absence of obvious distention may be very misleading. At this stage the patient is ordinarily given a brisk cathartic followed by an enema. Following the enema the nurse will report that the patient has had a large stool and feels better. This is a most disastrous event, as the lower bowel only has been evacuated and the patient's condition remains unchanged. We are also informed frequently that after the passage of the enema or the rectal tube the patient has passed gas. We should never be satisfied with the statement that the patient has passed gas unless it is independent of such manipulations. There is no question that the diagnosis is often very difficult. One hesitates naturally very strongly to offer to a patient whose strength and courage have been much reduced by a recent operation the necessity of reopening the abdomen, and those of us who have been through this know how difficult an operation may be under these conditions. When time allows, that is, when the symptoms are not very acute and the patient's condition is good, it has been my custom to demonstrate, if possible, whether or not the intestinal tube is patent by the administration of powdered charcoal followed by a brisk cathartic. If the charcoal comes through within a few hours of course we have a convincing demonstration that a complete occlusion at least does not exist. The helpfulness of this procedure is well illustrated in the following case:

> (Case 14.) Appendectomy 4 years ago. Admitted March 5, 1914. Nineteen days previously began to have evident symptoms of increasing obstruction. On admission patient was quite ill, was vomiting, abdomen distended. Given a half ounce of charcoal. Next day stool colored with charcoal. Did not vomit all day. Slept well. March 7, vomited again but condition remained good. March 8, more charcoal given which later was vomited. At operation an obstruction was found resulting from adhesions of the cæcum to the mesentery of the ileum. The obstruction was then apparently total.

Paralytic Ileus.—By paralytic ileus we mean for the most part the arrest of peristalsis coming in the presence of a septic process and

presumably due to it. There probably is a very much smaller class in which no septic manifestations are present but merely a reflex inhibition as the result of the irritation or shock of operation. One sees occasionally such a condition developing spontaneously in elderly people after an injury which puts them to bed but has not directly acted upon the abdomen. Such a degree of stasis would ordinarily yield to time or to the influence of acceleration of peristalsis. It must, however, be presumed that the intestine will act as will the bladder, in that a certain amount of distention increases its already diminished tonus, and I can remember cases which have ended fatally, without obvious inflammatory manifestations, which might have been saved if earlier and more energetic measures at securing peristalsis had been employed.

The picture of paralytic ileus is ordinarily that of septic peritonitis coming more particularly after operations for the relief of conditions such as appendicitis or intestinal obstruction. The patient's general condition is that of sepsis; the abdominal symptoms are particularly those of tympanites, pain, tenderness and marked rigidity of the abdomen, persistent and repeated vomiting and the absence of stool or flatus. The condition is progressive and the patient dies usually in about three days. It will be noted that there is no response to catharsis. Some one has remarked that it is like trying to medicate a lead pipe. There may sometimes be an appreciable difference between this form and mechanical obstruction. In the latter there may be some attempts at peristalsis in the proximal segment of the gut, as evidenced by a certain amount of gurgling and cramp-like pain referred to at some definite point of the abdomen, perhaps corresponding to the site of the obstruction.

In former years, like most of my colleagues, I thought that the inhibition of peristalsis resulting from a peritonitis could not be cured. I must acknowledge to-day that probably the graver forms must necessarily be fatal, but my experience with a new form of therapy in the last three years leads me to think that many of these cases can be saved, intestinal function reëstablished and the patient recover providing the degree of existing sepsis is not too virulent to be overcome by the body resistance. I refer now to the use of pituitrin which I consider a veritable life-saver and which, perhaps, has given me my chief excuse for writing this paper. All previous forms of intestinal excitants had failed me in grave cases, including eserin, the deadly hormonal, intravenously, and even the unjustifiable croton oil. Enterostomy, although

giving an occasional success to an occasional operator, has never seemed to me of value in treating paralytic ileus and certainly has never succeeded with me. Admitting for the sake of argument that enterostomy may rarely overcome a paralytic ileus I feel very strongly that it should not be resorted to until a trial with pituitrin has been made.

My attention to the possible value of pituitrin was suggested in 1912 when I learned of its value in stimulating uterine action and it occurred to me then that what was good for one smooth muscle might be good for another. At that time, so far as I knew, its use as a peristaltic accelerator had not been tried, although I find from subsequent investigation that Moynihan gives credit to Blair Bell (*British Medical Journal,* December 4, 1909) for the use of pituitrin as a stimulant for the intestinal muscle. I began to use it in all such cases and have used it frequently ever since and am now firmly convinced of its value.

ILLUSTRATIONS OF USE OF PITUITRIN

Case I.—Mrs. E. Seen in consultation forty-eight hours after laparotomy for tubo-ovarian condition. Twenty-four hours after operation pulse 140, temperature 104½°. When seen by me presented a condition of septic peritonitis. Abdomen markedly distended, tender and rigid all over. Two doses of pituitrin were given, followed by passage of flatus and stool, prompt relief of symptoms and eventually good recovery.

Case II.—Mrs. P. Hysterectomy one month previously. Symptoms of increasing partial obstruction for about a week. Apparently of mechanical variety and not complete. One dose of pituitrin was followed by marked collapse, but patient passed gas and had a stool fifteen minutes later; made a prompt recovery as regards obstruction. Convalescence delayed, as patient was markedly septic with streptococcus viridans, but eventually recovered completely.

Case III.—C. A., ten years old. Appendicitis of seven days' duration, general peritonitis, post-operative, much distended, and after two days' vomiting received small amount of pituitrin. Flatus was passed and night was noted more comfortable than any he had had. He received subsequent doses of pituitrin on the third and fourth days. The administration of the first dose seemed to mark a turning point in the progress of the case.

Case IV.—Miss F. (Case 8). Intestinal obstruction and general peritonitis. Resection of two feet of terminal ileum. On the third day after operation patient vomited four times. Enema not effectual. Late that day pituitrin given, second dose in two hours.

Next day three doses of pituitrin were given. After the second dose enema given; returned light brown in color with some fæces. After third dose flatus was expelled by rectum and a few hours later considerable flatus expelled with some fecal matter. Patient made a good though tedious convalescence.

CASE V.—Mrs. B. (Case 18). Salpingo-oöphorectomy three months previously. No movement of the bowels for five days. Obstruction evidently in descending colon. Patient's condition was good. First dose of pituitrin given at 8.45 A.M., on day of patient's admission. 9.30 A.M., enema returned brown fluid with many particles of brown fecal matter. Considerable flatus expelled 10.45 A.M., second dose of pituitrin. 11.45 A.M., quantity of flatus expelled. 12.45 P.M., third dose of pituitrin. 1.00 P.M., quantity of flatus expelled. Subsequently an artificial anus was made in the cæcum in two stages, there being an interval of five days.

Of late I think many operators are using pituitrin and with good success, but at the same time I am astonished to find men of large experience who have no knowledge of its possibilities. For instance, within six months one of the most active surgeons in America described a successful case of enterostomy for paralytic ileus. I asked him if pituitrin had been unsuccessful in this case and he stated that he was not aware of its value. I find little reference to it in recent standard works on surgery. In Johnson's *Operative Therapeutics,* 1915, it is stated under the section on appendicitis that in paralytic ileus "recently pituitary extract has given excellent results in a few cases." *Murphy's Hand-book,* 1915: "Pituitrin was used with good result in two cases of intestinal obstruction by N. Porritt." Moynihan, *Abdominal Operations,* Third Edition, 1914: "I have tried the substance in perhaps a dozen cases . . . that it is without doubt a valuable if a capricious remedy."

The Methods of Using Pituitrin.—In any form of organotherapy it is most important to have fresh and stable solutions. I am not personally familiar with the comparative merits of the various preparations on the market. The only one that I have used is made by a firm enjoying a good reputation for the reliability of its products. The pituitrin is administered hypodermatically in the muscles. It has been my custom, depending on the necessities of the case, to give an ampoule (1 c.c.) of the preparation and repeat every hour up to three doses; subsequent doses two hours apart. I have never given more than five doses in twenty-four hours. For cases of the milder variety the second injection usually brings about the passage of gas in considerable quan-

tities and often causes a spontaneous stool. The effects may of course be reënforced by a suitable enema.

As yet, I have not felt it wise to use pituitrin intravenously, as is recommended by some, though it is possible that I may do so, using it in small quantities. In Case II the whole dose was evidently accidentally administered intravenously. It was followed at once by a terrific collapse endangering the patient's life, but she subsequently recovered not only from the collapse but also from the obstructing condition.

Any form of hypodermatic medication which, like pituitrin, can be administered without resulting irritation to the stomach of course presents great advantage, especially in those conditions in which the patient has a tendency to vomiting as will naturally exist in most of these cases for which pituitrin is indicated. In fact, so pleasant is the effect of pituitrin that I occasionally use it in the less serious cases where medication by mouth is unpleasant or pretty quick results are desired.

Summary of Twenty-four Cases of Post-Operative Obstruction

(A) obstruction occurring in convalescence

Case	Duration of obstruction	Part of intestine involved	Operation	Time elapsing from previous operation	Result	Original operation	Male or female
1	5 days	Small intestine	Artificial anus	16 days	Died	Incisional hernia	Female.
2	2 days	Small intestine	Separation of adhesions	6 days	Died	Appendix	Male.
3	24 hours	Small intestine	Artificial anus	10 days	Died	Appendix	Male.
4	24 hours	Small intestine	Separation of adhesions	14 days	Cured	Appendix	Male.
5	36 hours	Small intestine	Artificial anus	5 days	Died	Pelvic organs	Female.
6	24 hours	Small intestine	Artificial anus	2 days	Died	Strangulated umbilical hernia	Female.
7	24 hours	Small intestine	Artificial anus	5 days	Died	Appendix	Female.

(B) late obstruction

8	36 hours	Ileum	Resection	15 months	Cured	Appendix	Female.
9	3 days	Ileum	Resection	1 year	Died	Appendix	Female.
10	2 days	Ileum	Resection	1 year	Cured	Pelvic organs	Female.
11	2 days	Small intestine	Artificial anus	9 months	Died	Pelvic organs	Female.
12	24 hours	Small intestine	Artificial anus and resection	21 years	Died	Pelvic organs	Female.
13	chronic	Cæcum	Separation of adhesions	8 years	Cured	Pelvic organs	Female.
14	19 days	Small intestine	Cutting of band	4 years	Cured	Appendix	Male.
15	2½ months	Small intestine	Separation of adhesions	3 months	Cured	Appendix	Male.
16	4 days	Small intestine	Separation of adhesions	6 years	Cured	Appendix	Female.
17	3 days	Small intestine	Separation of adhesions	2 years	Died	Pelvic organs	Female.
18	5 days	Large intestine	Artificial anus	3 months	Cured	Pelvic organs	Female.
19	3 years	Cæcum	Separation of adhesions	8 years	Cured	Pelvic organs	Female.
20	1 month	Small intestine	Resection	3 months	Died	Appendix	Male.
21	1 day	Lower ileum	Separation of adhesions	2½ years	Died	Strangulated ventral hernia	Female.
22	2 days	Ileum	Cutting of band	25 days	Cured	Appendix	Male.
23	2 days	Small intestine	Separation of adhesions	4 months	Died	Pelvic organs	Female.
24	4 days	Small intestine	Artificial anus	7 years	Died	Pelvic organs	Female.

Total.—Twenty-four cases: Male, 7; female, 17.
In 11 cases previous operation for removal of appendix.

Deaths, 14: Occurring in convalescence, 6; occurring late, 8.
In 10 cases previous operation for diseases of female pelvic viscera.

THE PREVENTION OF FECAL FISTULA IN SUPPURATIVE APPENDICITIS

By Donald Guthrie, M.D.

of Sayre, Pa.

surgeon to robert packer hospital

Granted that we are operating for ruptured or suppurative appendicitis, are there any measures to be carried out that will safeguard the patient against the development of a fecal fistula? We believe that there are, in spite of the fact that fistulæ occasionally develop in cases where no attempt has been made to remove the appendix, and, too, that some surgeons who pay no particular attention to the treatment of the stump in these cases do not get fistulæ. In describing this method, we realize that there are several ways of doing the same thing correctly and undoubtedly many ways different from ours that have worked just as well in the hands of other surgeons.

We consider the following factors of importance. First, the incision. Our choice is the muscle splitting or McBurney in most of the cases. In those who have well-defined abscesses lying near the midline, we make a straight incision over the most prominent part of the mass. A muscle splitting incision gives a better post-operative wound, I believe, especially should sloughing occur. There will not be as much gaping and this will not allow as much of the cæcum to become adherent to the edges of the incision. Protrusion of the cæcum through the wound may cause a fecal fistula. The liability of post-operative hernia is less if this incision is used.

Second, treatment of the stump. Whenever possible we invert the stump, using an absorbable purse-string suture of catgut after it has been carefully ligated with catgut. A second purse-string or a few interrupted sutures of catgut are used for further reinforcement. Permanent sutures of linen or silk in the presence of infection are prone to be followed by a persistent sinus and I have operated on fistula cases in which I have been able to recover the suture. When perityphlitis is present to a marked degree and the head of the cæcum has become so thickened by inflammation that inversion of the stump is impossible, we resort to the old cuff operation, turning down a fold of the thickened peritoneal coat, ligating the stump with catgut and then covering it over with the cuff tied by catgut. These methods are better, I believe,

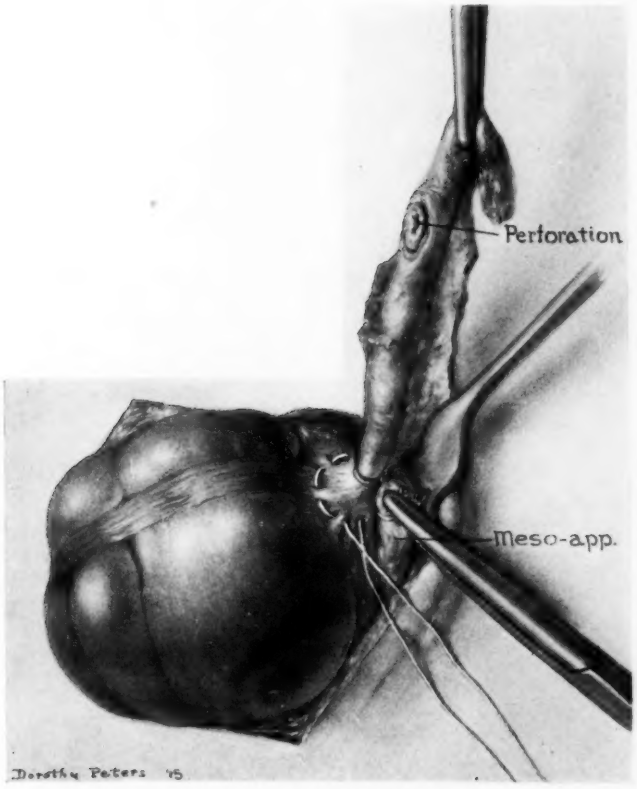

FIG. 1.—Showing purse-string suture of catgut and clamp on severed meso-appendix.

FIG. 2.—Purse-string suture tied. Reinforcement with several interrupted sutures of catgut.

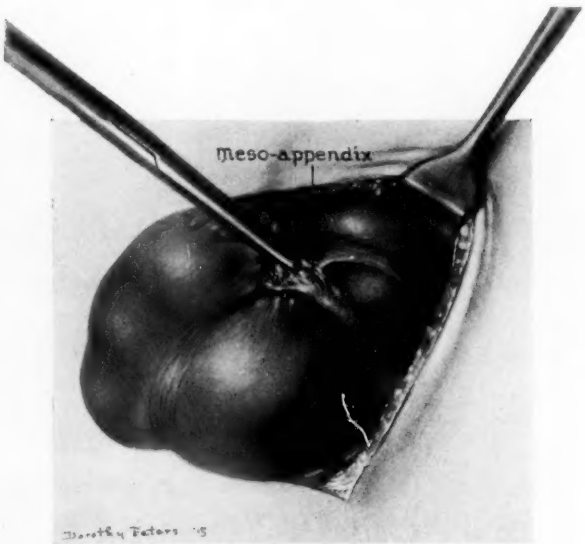

FIG. 3.—Meso-appendix drawn over suture line and secured.

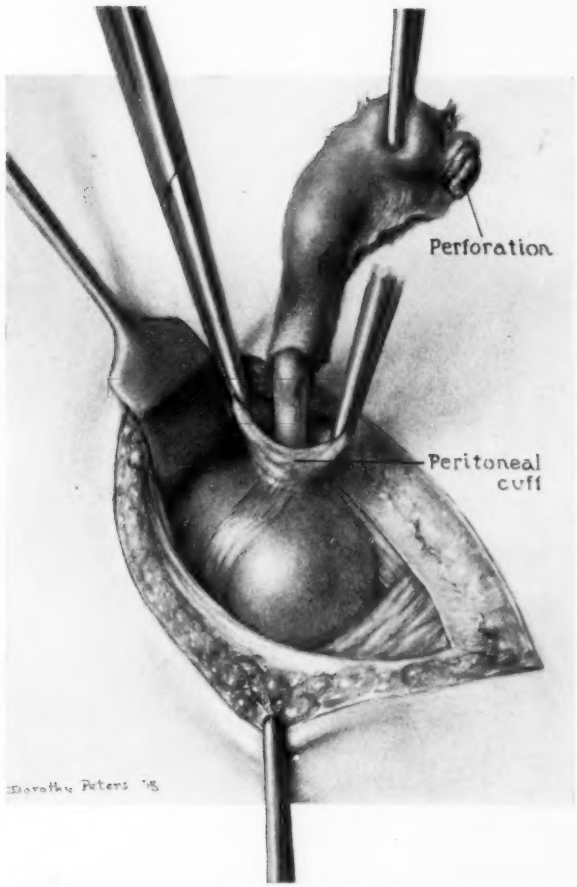

FIG. 4.—The peritoneal cuff operation is employed when it is impossible to invert stump.

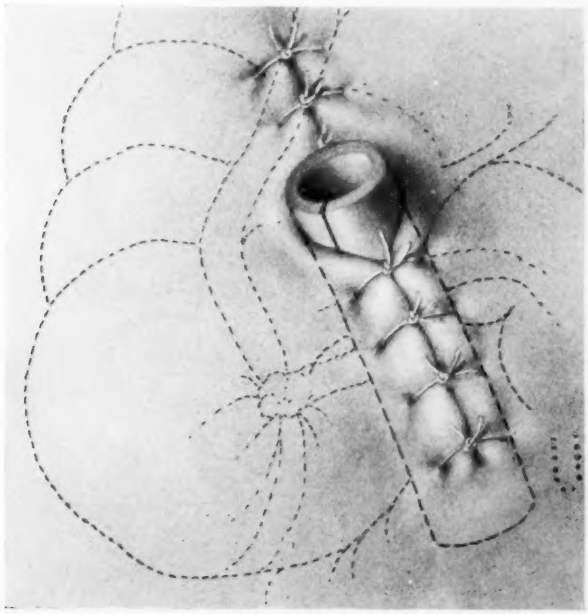

FIG. 5.—Diagram showing drainage tube placed well away from head of cæcum.

than simply tying off the stump and dropping it back into the abdomen. After the stump has been inverted by the catgut suture, or the cuff operation employed, we aim to further reinforce the field by tying in the cut meso-appendix. This is not possible in every case, and when impossible, we use a tip of omentum if it can be found or some organized lymph from an abscess wall.

Third, drainage. We never use gauze as a drain *per se* as it will not drain pus after a few hours, but it is occasionally used to control hemorrhage, and whenever it is used it is placed well away from the head of the cæcum and removed as early as possible. Gauze placed near a suture line, especially a permanent suture line, will tend to cause fistulæ. We never employ drainage in any form of abdominal tuberculosis, believing that a mixed infection with this condition is almost sure to develop a fecal fistula.

Our drainage tubes are of soft rubber and of large calibre. They are placed away from the head of the cæcum as far as possible, shortened early, and removed, as a rule, by the end of the first week. Fistulæ have been caused in some cases by a too prolonged contact between the head of the cæcum and the drainage tube. We never give laxatives until all drains have been removed.

In the past five years and three months (June, 1910–1915) my associate, Dr. S. D. Molyneux, and myself have performed 2,658 abdominal operations. Of this number 1,114 were operated upon for appendicitis primarily and do not include 698 cases in which diseased appendices were removed during the course of other operations. Of the 1,114 appendix cases, 298 patients had ruptured, gangrenous, or suppurative appendices in whom drainage was employed. Besides this number we have drained the abdomen in 555 cases for other infections, making a total of 853 drainage cases.

We have had three fecal fistulæ develop in the 853 drainage cases. One, following a pyosalpinx operation, which healed spontaneously; one, the drainage of a large appendiceal abscess, in which no attempt was made to locate the appendix—this fistula healed spontaneously; one, a fistula developed in the case of a boy who was operated upon for ruptured appendicitis with general peritonitis. The abdomen was drained freely. The boy required gastric lavage every three hours for four days and I believe the trauma to the head of the cæcum by the tubes caused this fistula. He required operation to close two holes in the head of the cæcum.

RECENT CLINICAL AND PATHOLOGICAL OBSERVATIONS ON GIANT-CELL MEDULLARY BONE TUMORS*

By F. R. Haussling, M.D.
of Newark, N. J.
surgeon, city hospital
and
H. S. Martland, M.D.
pathologist, city hospital

PART I. REPORT OF A HITHERTO UNDESCRIBED FORM OF MULTIPLE BONE TUMORS. MULTIPLE NON-SUPPURATIVE CHRONIC HEMORRHAGIC OSTEOMYELITIS

This case presents multiple expansive bone tumors, the clinical picture resembling that of multiple myeloma; the microscopical appearance of the tumors, however, is that of the so-called medullary or myelogenous giant-cell sarcoma or chronic non-suppurative osteomyelitis of Barrie.[1] Multiple tumors presenting this microscopical appearance have hitherto been undescribed.

Case I.—*History.*—T. K., female, age twenty-five years, married, housewife, admitted to City Hospital June 2, 1915. Family history negative. Past history, had measles in childhood. Denies venereal disease. Has had four normal births, one miscarriage. In February, 1914, patient had a miscarriage, she lost considerable blood and has never been well since, complains of weakness, dyspnœa and palpitation on exertion. In August, 1914, she, for the first time, noticed an enlargement of the right superior maxilla. In October, 1914, she fell and broke her right femur, about six inches above the knee-joint; treatment in the City Hospital resulted in firm union without deformity. In February, 1915, she noticed a second mass on the anterior surface of the left tibia, about its middle third. This grew for two months and attained the size of a hen's egg; it since has remained stationary in size. In May, 1915, she gave birth to a full-term healthy child. In June, 1915, she was admitted to City Hospital complaining of dyspnœa, weakness, cardiac palpitation and slight bone pains.

Physical Examination.—Showed a well-developed female, with fair nutrition (Fig. 1). Saddle nose, due to trauma in childhood. Heart in sixth interspace, outside nipple line, with a loud systolic murmur. Lungs, suspicious signs of early tuberculous involvement of left upper lobe. Physical examination otherwise negative,

* Presented before the New York Pathological Society, November, 1915.

with exception of multiple, palpable bone tumors, varying in size from that of an English walnut to that of a hen's egg, and situated as follows: The inner wall and floor of right orbital cavity, and superior maxilla; the left clavicle, at its sternoclavicular articulation; the right clavicle near its acromial end; the left tibia on its anterior surface, near its middle third; and the seventh rib on the right side.

Röntgenograms (Figs. 2, 3, 4, 5 and 6) showed in addition to the palpable tumors, expansive tumors in the following locations: The right femur above the knee-joint; right fibula, upper third; and left fibula, upper third. Later röntgenograms showed a tumor developing in the right humerus just above the elbow and one in the pelvis.

Laboratory Examination.—The following laboratory examinations were made: Hæmoglobin, 75 to 85 per cent.; erythrocytes, 4,020,000, no abnormals; leucocytes, 5200 to 9600, no abnormals; blood Wassermann negative, three times; spinal fluid Wassermann negative, with normal cell count and globulin. Several 24-hour urine specimens were examined, especially for Bence-Jones albumose, with negative results. The urine always showed a trace of albumin, with a small number of hyaline and granular casts. Otherwise the urine was normal.

Clinical Diagnosis.—Multiple myeloma, cardiac dilatation and failing compensation.

Progress Notes.—On June 28, 1915, in order to establish a positive diagnosis, we removed the growth on the left tibia with the curette, revealing a small localized cavity containing what appeared to be well-organized red granulation tissue with considerable bleeding. The cavity was swabbed with pure carbolic followed by 95 per cent. alcohol, and wound sutured tight. Wound healed by first intention. On microscopic examination of this tissue, we were surprised to find the typical lesion of the so-called giant-cell myelogenous sarcoma. Believing this to be a benign lesion, from previous experience, we decided to attempt to remove by means of the curette all of the accessible tumor masses. On August 16, 1915, a second operation was performed, exposing and curetting growths on the right fibula, left fibula, left clavicle, right clavicle, seventh right rib, and right superior maxilla. These lesions varied from the size of a pigeon's egg to that of a hen's egg, all tumors were covered by smooth, bulging periosteum, were sharply localized with no tendency whatever to break through their bony shell and consisted of what appeared to be firm red granulation tissue, which curetted away in small masses. After thorough curettage the smooth wall cavities were swabbed out with carbolic and 95 per cent. alcohol, allowed to fill with blood

and the skin wounds sutured without drainage. The wounds united by primary union.

Microscopic Examination.—Microscopic examination of the tissue removed from the various tumors showed in each case the typical picture of the so-called myelogenous giant-cell sarcoma (Figs. 7, 8, 9, 10, 11 and 12).

Subsequent Notes.—The patient's physical condition has greatly improved, and her cardiac condition has become fully compensated. The tumors curetted still show in röntgenograms, and new ones are slowly making their appearance. On November 26, 1915, the lesion on the lower end of the right humerus was incised; this tumor mass proved to be quite cystic, with very little of the characteristic tissue in its walls.

Summary.—So far as we can find:

(1) Multiple, primary, expansive, slow-growing bone tumors, with the clinical picture of multiple myeloma but with the histological picture of chronic non-suppurative hemorrhagic osteomyelitis (giant-cell sarcoma), have hitherto been undescribed.

(2) The tumors are too numerous to consider trauma as an etiological factor.

(3) It is of course impossible to say what the ultimate outcome of this case will be. Although the disease is undoubtedly not arrested, as is conclusively shown by the appearance of new lesions, there has been up to the present time no tendency for the growths to break through their bony covering, or infiltrate the surrounding soft parts or form metastases. Nor has the patient's general health deteriorated.

Treatment.—All accessible tumors should be removed with the curette, swabbed out with phenol and alcohol, the cavity allowed to fill with blood clot and the skin wound closed without drainage. We feel that this is the logical treatment, since it has been proved to be curative in so-called giant-cell sarcoma having the same histological picture, and also it relieves the moderate pain which accompanies these growths.

PART II. REPORT OF A CASE OF GIANT-CELL MEDULLARY TUMOR OF THE USUAL TYPE, NAMELY A SINGLE BONE TUMOR

This case presents an expansive tumor involving the lower end of the right tibia, of over eight years' duration, which on microscopical examination shows the typical picture of the so-called medullary or myelogenous giant-cell sarcoma. We present this case to demonstrate the benign character of this type of tumor and its chronicity.

CASE II.—A. L., Italian, twenty-eight years of age, barber, admitted to City Hospital March 14, 1910. Discharged June 5,

1910. Family history negative. Personal history, chancre when eighteen years of age, treated one year.

Present History.—Three and one-half years prior to admission, while playing ball, patient stepped into a shallow hole twisting his ankle so that he was immediately unable to support his weight on it. Pain, swelling and disability persisting, the ankle was encased in plaster for about three weeks. Following this, antiluetic treatment was instituted for one month. The ankle failing to improve was again put up in plaster for one and one-half months; there being no improvement at the end of this time, he entered the hospital, where the lower end of the tibia was curetted, but no diagnosis made. He left the hospital at the end of five weeks and had no further trouble for eighteen months, when the swelling and pain gradually returned. The lesion was again curetted, after which he was able to work at his occupation for about seven months. In January, 1910, he fell and again injured his ankle; considerable bleeding taking place from the sinus which has persisted since his last operation. On admission to the Newark City Hospital, March 14, 1910, patient complained of intense pain in left ankle, markedly aggravated by walking, and presented a uniform enlargement of the lower end of the tibia, very little if any smaller than its present size with a healed scar on the inner aspect. The skin over the enlargement was otherwise normal in appearance. On palpation there was moderate tenderness. No egg-shell crackle. The patient has lost 25 pounds in weight.

Operation (March 21, 1910).—Ether anæsthesia, elastic constriction, thorough curettage of lower end of tibia with removal of what appeared to be a large amount of red granulation tissue. The process had extended to, but had not involved, the ankle-joint, and was entirely limited to the tibia, although it appeared to have replaced all the bone with the exception of the thin shell adherent to the periosteum which it had caused to bulge. Patient was discharged from the hospital on June 5, 1910, entirely free from pain, with a movable ankle, no diminution in size of swelling and a small discharging sinus. March 7, 1911, readmitted because of local recurrence. Sinus present, admitting probe two inches. On outer edge of sinus tissue heaped up in a mass which somewhat resembled a strawberry in size and appearance. No pain. Thorough curettage with excision of recurrence on edge of sinus. Swabbed with phenol and alcohol. Packed with iodoform gauze. Discharged April 16, 1911.

Readmitted September 11, 1911, because of reappearance about one month ago of strawberry-like growth on edge of sinus which had failed to entirely close. No pain. Operation September 15,

1911, curettage fully as thorough as at first operation. Cavity swabbed with phenol and alcohol.

Operation (October 28, 1911).—Indication recurrence at edge of sinus.

Operation (November 28, 1911).—Recurrence again appearing at lower edge of sinus, curettage repeated. On discharge, December 6, 1911, general health excellent, no pain, sinus persisting, no evidence of recurrence.

Between this time and his readmittance, January 4, 1915, over three years later, had been able to follow his occupation as barber. His general health had remained good. No pain in ankle, but a sinus had persisted, which discharged a small amount of thin pus, and during the past five months had been the seat of several rather profuse hemorrhages. Recently a recurrence of the growth had also presented itself at the outer edge of this sinus.

Operation (January 5, 1915).—Curettage. The growth has changed somewhat in its macroscopic characteristics. While the small mass at the edge of the sinus again resembles exuberant granulation tissue, the bone cavity is no longer filled with the characteristic red jelly-like material, but consists of several cystic compartments containing clear fluid. Motion in ankle-joint is still good. March 28, 1915, discharged with sinus still present, no pain on walking, no evidence of recurrence; has gained fifteen pounds in weight (Figs. 13 and 14).

Summary.—The clinical history, operative findings and microscopic appearance undoubtedly classify this case under the heading of chronic non-suppurative osteomyelitis (Barrie), synonyms, giant-cell sarcoma, myeloma, and giant-cell tumor (Bloodgood). Our primary object in reporting this case is to show, that while there has been a fairly active and very persistent tendency to local recurrence, metastases have not occurred, and the man after a period of eight and one-half years is still in excellent health without pain and able to do his work, which requires that he be on his feet the greater part of the day.

Of course the ultimate outcome of this case is problematic. Too short a time has elapsed since the last operation to venture an opinion. From the economic stand-point, it might have been better to amputate early. The patient, even after these repeated disappointments and much time spent in the hospital, is still desirous and hopeful of saving his leg, and will not consent to anything more radical than curettage.

At present there seems to be a great difference of opinion as to the safety of curettage in these cases. Why should this be so? For practically all other tumors, the operative treatment has been standardized.

FIG. 1.—Case I. Presenting histological picture of medullary giant-cell sarcoma. Note growth encroaching on right orbit; also healed incisions over left clavicle near sternoclavicular joint, over right clavicle near acromial end and over rib in right axilla, where tumor masses were curetted.

FIG. 2.—Case I. Röntgenogram showing tumor in right antrum.

FIG. 3.—Case. I. Röntgenogram showing tumor in right femur.

FIG. 4.—Case I. Röntgenogram showing tumor in left fibula.

FIG. 5.—Case I. Röntgenogram showing tumor in right fibula.

FIG. 6.—Case I. Röntgenogram showing tumors in both clavicles.

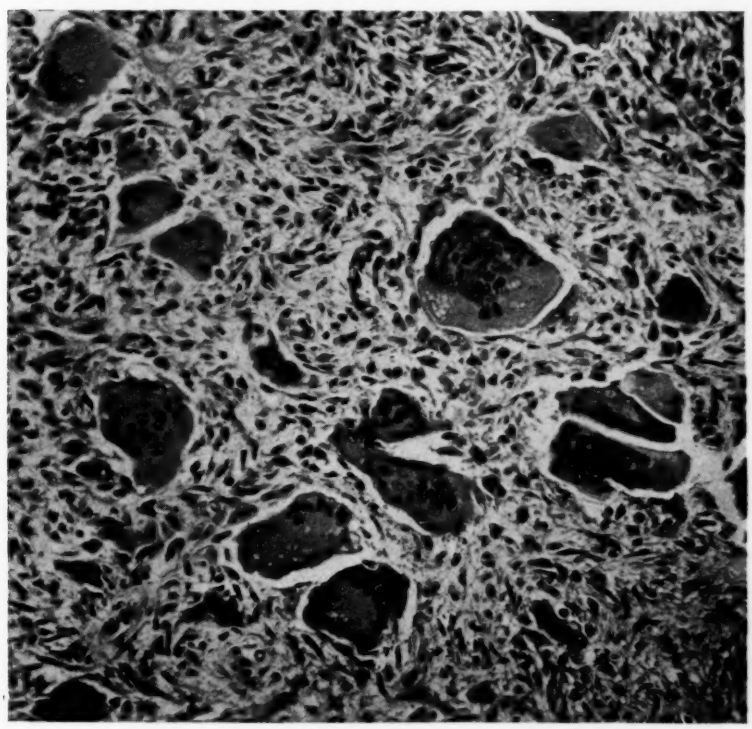

FIG. 7.—Case 1. Showing numerous giant-cells of the osteoclast type and fibroblastic stroma. Note absence of mitosis in giant-cells and in stroma (low power).

FIG. 8.—Case I. Showing giant-cells and fibroblastic tissue of stroma. Note erosion and disintegration of bone trabeculæ (low power).

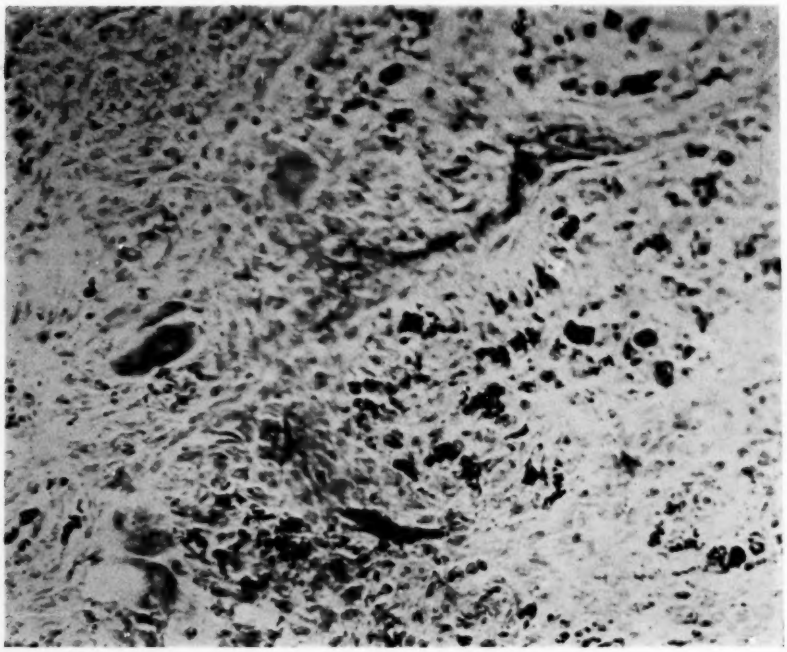

FIG. 9.—Case I. Showing giant-cells and fibroblastic stroma. Note hemorrhage in perivascular tissue and collections of blood pigment (low power).

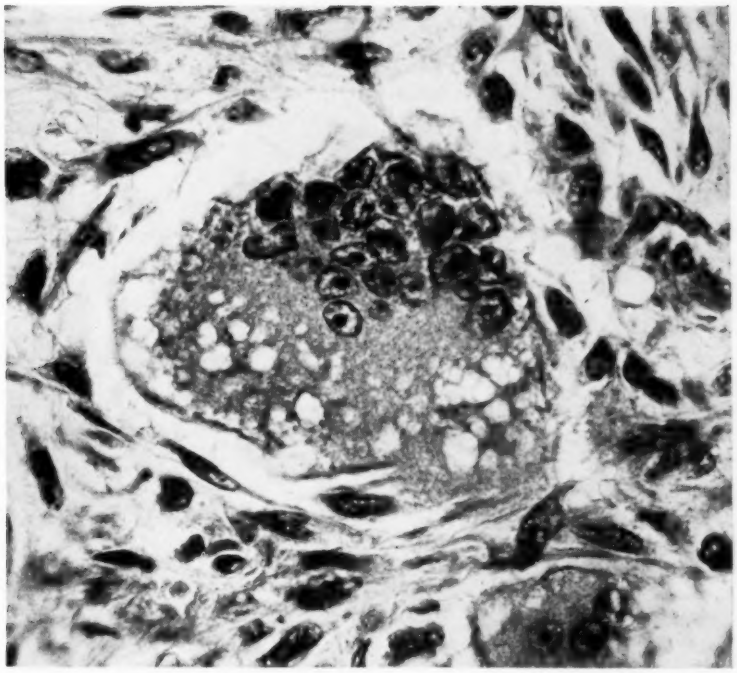

FIG. 10.—Case I. Showing a giant-cell of the osteoclast type. Note numerous, regular in size and shape nuclei, with absence of mitosis, dark-staining, abundant cytoplasm with vacuolation. Note absence of mitosis in stroma (high power).

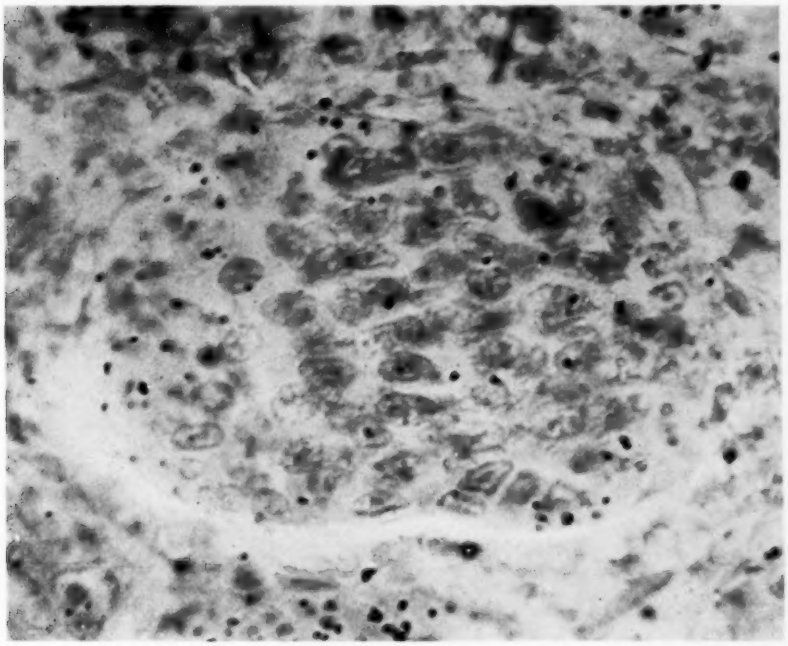

FIG. 11.—Case I. Showing a giant-cell of the osteoclast type, containing 80 nuclei, regular in size and shape, without active mitosis (high power). Mallory would contend that the fusion of endothelial leucocytes is responsible for such a cell. It is quite difficult to conceive of their origin in this manner.

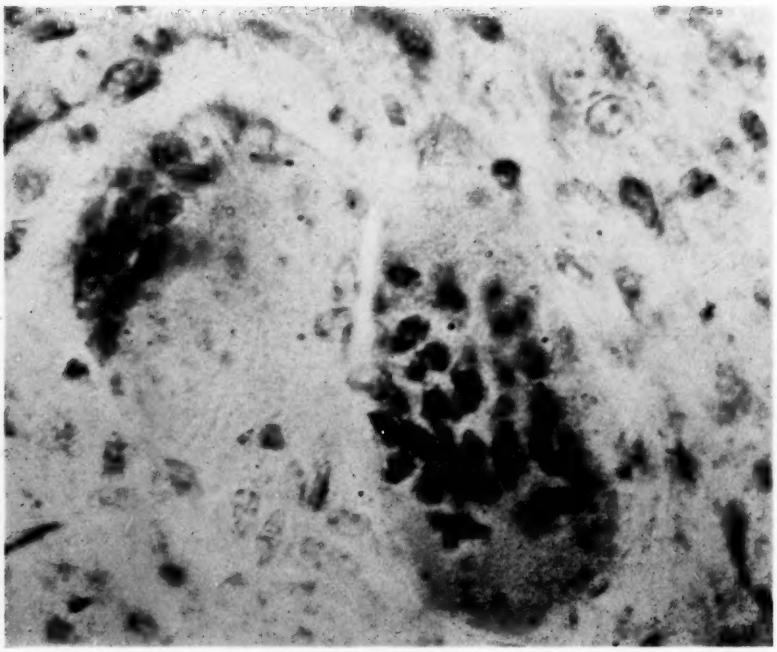

FIG. 12.—Case I. Showing two giant-cells of the osteoclast type, containing numerous nuclei, regular in shape and size (high power).

FIG. 13.—Case II. Note general health of patient is excellent, after eight years duration of tumor.

FIG. 14.—Case II. Showing appearance of leg eight years after onset of tumor. Note open sinus. Recurrence is always on edge of sinus.

In making a fairly careful review of the literature, we have been impressed with the striking difference in the macroscopic appearance of the growths reported. For example, Connell [2] describes two cases in detail, one easily cured by curettage, and the other requiring secondary amputation. His macroscopic descriptions of the findings at operation in the two cases are so different that they immediately make one question their belonging in the same class. In describing the benign tumor, he says, " with a curette, a sponge full of what appeared to be granulation tissue was removed for microscopic examination." While his description of the more malignant growth is as follows: " division of the periosteum exposed the tumor which was distinctly localized and was composed of lobules of whitish-gray, cheesy material with bony trabeculæ extending from the periphery toward the centre."

The true hemorrhagic osteomyelitis (benign medullary giant-cell tumor) has a very characteristic appearance. In fact, it has not the appearance of a tumor at all, but rather that of exuberant, very vascular granulation tissue, filling the expanded bone, resembling somewhat red-currant jelly. Of course, in arriving at an opinion, a microscopic report is indispensable; still, practically all the giant-cell tumors which have proven to be benign have macroscopically had this appearance of red jelly-like granulation tissue.

Barrie [1] would classify benign bone cysts, osteitis fibrosa, chronic osteomyelitis fibrosa (Bloodgood), and traumatic solitary bone cyst under one term—chronic fibrocystic osteomyelitis, this being a later stage of chronic hemorrhagic osteomyelitis due to metaplasia. The findings at the last operation in the above case would seem to verify this contention.

PART III. PATHOLOGICAL SUMMARY

Sarcoma occurring in or near the ends of long bones, endosteal, medullary, or myeloid in character, presenting a macroscopic picture characterized by a tumor formation which is circumscribed, does not infiltrate soft parts, is distinctly vascular, friable, and resembles red granulation tissue; and a microscopic picture, composed of numerous giant-cells, with abundant dark staining and often vacuolated cytoplasm, numerous, regular nuclei with absence of mitotic figures; a stroma consisting of fibroblastic granulation tissue without active mitoses, dilated and engorged blood-vessels, hemorrhage in the perivascular tissue, and erosion and disintegration of bone trabeculæ, has been recognized for many years under such terms as medullary or myelogenous giant-cell sarcoma.

Bloodgood,[3] in 1912, was the first in this country to seriously study the so-called medullary or myelogenous giant-cell bone tumors. He concluded that this type of tumor probably would never form metastases, but would recur *in loco* when not thoroughly removed; a fact that was recognized as early as 1895 by Koenig, Bergmann and Mikulicz. Bloodgood did not consider the tumor a sarcoma and for a more appropriate name termed it "medullary giant-cell tumor."

Adami,[4] in 1910, would consider the so-called medullary or myelogenous giant-cell sarcoma as a type of myeloma, and would speak of it as "giant-celled myeloma." He recognizes the giant-cells in this tumor as myeloplaxes, he states: " Myeloplaxes differ from foreign body giant-cells in that the nuclei are distributed evenly through the cell body, and in the absence of central degeneration of that body, and from parenchymatous (true tumor) giant-cells in that the nuclei are well formed and of uniform size (lacking mitotic figures). They are present normally in the red marrow of bone, as osteoclasts in Howship's lacunæ, and are the characteristic constituent " of giant-celled myeloma where they are present in enormous numbers. He further states, " That the giant-celled myeloma has the following characteristics: it grows locally, most often in the shaft (marrow) of long bones, or of the jaw; it may be of periosteal origin (as in giant-celled epulis of the jaw); its growth is expansible, leading to absorption of the surrounding bones; it is abundantly vascularized; *it does not form metastases;* . . . it does not recur on complete removal; . . . it is only necessary to remove the portion immediately involved, with a very small surrounding zone; histologically, it exhibits a body formed mainly of short spindle-celled elements of fibroblastic type, somewhat irregular in shape, varying from the typical spindle to polygonal cells, and among these are abundant giant-cells of the myeloplaxe or osteoclast type."

Adami,[4] in a foot-note, calls attention to Mallory's dissenting view as to the origin of the giant-cell encountered in these tumors, and of their importance in the tumor. He nevertheless considers them specific constituents of the tumor as much as the osteoclasts of Howslip's lacunæ are specific parts of normal bone.

Mallory[5] considers the giant-cells encountered in the so-called medullary or myelogenous sarcoma as " foreign body giant-cells, similar to the osteoclasts of normal bone," both of which he considers " are due to the fusion of endothelial leucocytes attracted into the tumor by the presence of lime salts which they dissolve and remove. They signify usually disintegration of bone, rarely the presence of fat and fat crystals. The tumor containing foreign body giant-cells should be classified

according to the nature of the other cells present in the tumor; the foreign body giant-cells should be disregarded. They do not signify either rapid growth or malignancy." He would attempt to make a diagnosis, by establishing the type cell in the tumor, and the malignancy of the tumor would depend on the presence or absence of mitosis in the stroma (for instance, benign or malignant fibroblastoma).

Barrie,[1] in 1913, called attention to the characteristic and microscopic appearances of the so-called medullary giant-cell sarcoma, forming a picture which is certainly entirely different from that encountered in malignant periosteal sarcoma or other malignant bone tumors. He believes that the process is not a tumor formation at all, but merely a chronic non-suppurating form of osteomyelitis, and has termed it "chronic non-suppurative hemorrhagic osteomyelitis."

It can be readily seen from the brief *résumé* of the opinions held by a few authorities, that it is quite impossible to correctly classify this tumor at the present time. Its correct interpretation is still a problem for future investigation. We are strongly of the opinion that Barrie's work remains the nearest approach to the proper interpretation of the lesion; although it would be still unwise to discard quickly the fact that the giant-cells found in these tumors may not be of bone-marrow origin and the tumor still belong in the myeloma class. Mallory certainly has not proven to our satisfaction that the enormous number of giant-cells encountered, with their regular and numerous (50 to 80) nuclei, can be explained by the fusion of endothelial leucocytes. The condition of the stroma in our opinion is much in favor of an inflammatory process, rather than a new-growth, and is the greatest argument in favor of Barrie's interpretation of the lesion.

Complex and as unsatisfactory as the scientific classification of this tumor is, there remains one important fact upon which most authorities have agreed, namely, that the giant-celled myelogenous or medullary sarcoma is not a malignant tumor. It does not produce metastases. While proper classification of all tumors should be the aim of pathologists, it frequently is quite difficult, and is often of secondary value; the real vital question to determine is whether a growth shall be considered benign or malignant. Adami, Bloodgood, Ewing, Barrie and numerous others, including ourselves, consider this tumor as benign.

Coley, we take it, from a review of his writings on sarcoma of the long bones,[6] and from his discussion of our cases at the New York Pathological Society in November, 1915, claims that the differentiation between malignant and benign medullary bone tumors often cannot be

made, either from their gross appearance at operation or from their microscopic picture when studied later. We are not of this opinion.

From our experience with these bone tumors, we would express our conclusions as follows:

(1) That medullary giant-cell sarcoma, myelogenous giant-cell sarcoma, myeloma, medullary giant-cell tumor (Bloodgood), and chronic hemorrhagic osteomyelitis (Barrie), are synonyms for a bone lesion usually occurring in or near the ends of long bones.

(2) That this bone tumor has a typical macroscopic picture, a typical picture in the gross that is absolutely characteristic; and if the surgeon is acquainted with this picture, he can almost always at operation distinguish these tumors from malignant periosteal sarcoma or other malignant bone tumors. The typical gross appearance referred to is that of an expansive, well-circumscribed, non-infiltrating bone tumor which is usually confined within the periosteum; on breaking through the bone shell the tumor proper is composed of reddish, young, granulation tissue, which has been described as resembling red-currant jelly, fresh cut liver, schmierkase and red bar-le-duc.[2] This tissue is soft, friable and very vascular, causing considerable bleeding. There are frequently seen small whitish bodies varying in size from that of a grape seed to a pea (areas of osteitis fibrosa), and small cystic cavities. Both of these are evidence of metaplasia, and if at all active may convert the lesion, by fibrous replacement of the granulation tissue and retraction with consequent cyst formation, into the chronic fibrocystic osteomyelitis of Barrie—synonyms, benign bone cyst, osteitis fibrosa, chronic osteomyelitis fibrosa—cystic or solid (Bloodgood), traumatic solitary bone cysts (Felten and Stolzenberg).

(3) That the pathological histology is absolutely characteristic and that there is usually no difficulty for any trained pathologist to readily distinguish it from other malignant bone growths. The typical histologic picture referred to is characterized by the presence of numerous giant-cells of the osteoclast type. These cells have an abundant, dark staining, often vacuolated cytoplasm and contain numerous nuclei (20 to 70 or more) which are regular in size and shape, vesicular, and show an absence of mitotic figures and deep nuclear staining. The stroma consists of young fibroblastic granulation tissue without active mitosis, dilated and engorged blood-vessels, hemorrhage in perivascular tissue and erosion and disintegration of bone trabeculæ.

(4) That the lesion is a benign one; *it will never form metastases;* amputation is therefore seldom indicated. Amputations in general for bone sarcoma are of very limited use, as periosteal sarcoma, practically

the only malignant form of primary bone tumor, has seldom been saved even by early amputation. There have been a few cases in literature of so-called giant-cell sarcoma supposed to present the above typical gross and microscopic appearances that have caused the death of the patient from metastasis. Mitchell Henry's case,[7] 1858, is too ancient and the picture too poor to draw any accurate conclusions. Coley's case [8] started as an ossifying myostitis, and its histological appearance has been doubted by Bloodgood. Bloodgood says,[9] "Every now and then . . . I have been informed of a case of giant-cell sarcoma in which the patient dies of metastasis. Some of these tumors I have been able to investigate and have found that the tumors were not giant-cell, but the most malignant sarcoma of the cellular type containing some giant-cells, and that, when the metastatic tumors have been examined, there were no giant-cells."

(5) The macroscopic and microscopic appearances encountered in Case I (the case presenting multiple bone tumors) are identical with that seen in Case II (the single bone tumor case); in fact, microscopic slides of each case cannot be told apart. It is therefore unnecessary to describe the multiple case in more detail, except to state that in every respect it seems to resemble the single lesion.

We believe, therefore, that the multiple case represents a clinical and pathological entity never described before in literature, that it presents the characteristic gross and microscopic appearances encountered in the single lesion, that it is not malignant, as it will always remain confined to the bones and will not form metastases. It should be classified therefore according to the classification of the single lesion, namely, as a multiple form of non-suppurative chronic hemorrhagic osteomyelitis; or if the single lesion is a form, namely, myeloma, as Adami thinks, it would be a new histologic form of multiple giant-celled myeloma, or a new form of multiple myeloma.

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THE TRANSPLANTATION OF BONE IN UNUNITED FRACTURES OF THE SHAFT OF THE HUMERUS*

By Melvin S. Henderson, M.D.

Mayo Clinic, Rochester, Minn.

A fracture through the shaft of the humerus is occasionally quite troublesome to handle. The patient is able to be about, which makes adequate fixation of the fracture difficult; this is the chief cause of the occasional non-union.

The records of the Boston City Hospital from May 24, 1864, to December 31, 1905, showed a total of 38,627 fractures. There were 3517 fractures of the humerus in this number, *i.e.*, fractures of the humerus formed 10.16 per cent. of the total. The radius was the only bone which was fractured more frequently.

The technic developed in treating ten cases of ununited fractures of the shaft of the humerus by transplantation of bone seems worthy of presentation. I shall not consider recent fractures. The operation itself is only a part of the treatment; the result which should follow an operation properly performed as to mechanical principles and technic is not obtained if the after-care and retentive splint are omitted. The spica type of plaster-of-Paris case is the most effective fixation for these fractures and can be worn comfortably for months if necessary.

Non-union of any bone is, comparatively speaking, very rare. I mean if the word "non-union" is limited to those fractures in which there is no evidence of union, after the lapse of the normal period of bone repair. In the Mayo Clinic the tibia, more often than any other bone, has been operated on for delayed union. If some months can be saved for the patient by such a simple procedure as that of the sliding inlay transplant,[1] when the facts have been presented, he will usually select the operation.

Just when "delayed union" becomes "non-union" is more or less arbitrary, and depends largely on the attitude of the surgeon. Statistics cannot be compiled when the personal equation enters so prominently into the consideration. On examining our records, it would seem as though a pseudo-arthrosis occurred more often in the humerus and femur than in any other bones. This condition undoubtedly would be present in many of the tibias but for the fact that the fibula is usually

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intact or, if fractured, will have united, preventing the free mobility necessary to establish a false joint. In cases where both the fibula and the tibia were ununited there was a typical flail or false joint.

Hamilton [2] has stated that non-union results more often after fractures of the shaft of the humerus than after fractures of the shaft of any other bone, due to the inadequate fixation provided both at the primary setting and during the convalescent period. Because we have operated on and observed more cases of delayed union in the tibia, does not prove that they are the most common. Many of the tibias that were operated on would undoubtedly have united after more protracted conservative measures. Usually the transplantation of bone was advised and undertaken merely as a means of saving time, which is so important to patients in the active period of life.

The cases used as a basis for this report were all old fractures, and in all the primary setting of the fracture had been done elsewhere. We have as yet to see a case of non-union in the shaft of a long bone which has been treated in our clinic from the time of the fracture. This is the experience of most surgeons, and emphasizes the fact that with the possible exception of intracapsular fractures of the neck of the femur, cases of non-union are rare. The use of metal plates, wire, etc., has practically been abandoned in our clinic, and for all delayed and ununited fractures, bone is transplanted.

Two distinct methods are used, one in which the bone is used as an intramedullary plug (Murphy [3]), and the other, the inlay method (Albee [4]). Both methods have their merits but the inlay appeals to one as being the more surgical procedure. It is now used in nearly all our work. The chief difficulty in handling these fractures of the humerus is to maintain adequate fixation after the bone transplant has been inserted. To put in the transplant and afterward put on a poor retentive apparatus is a useless procedure in the majority of cases.

Some of these patients present themselves with musculospiral paralysis. It is impossible to know in what percentage of fractures of the humerus this condition is present. Von Bruns [5] says that in 73 cases of fractures of the humerus there was musculospiral paralysis in 8.4 per cent.

Of our 10 patients there were three with musculospiral paralysis at the time of our examination. The nerve was traced in two of these and the fibres were apparently intact. In another case, paralysis of the musculospiral nerve was produced by excessive manipulation and traction at the time of the operation. We knew the nerve had not been severed and a good prognosis was given, but it was 4 months before

there was any return of power and more than a year from the time of operation before complete function was restored.

Technic.—A few days before the operation a spica plaster-of-Paris cast is applied to the shoulder and arm of the fractured side. This gives as near perfect fixation as it is possible to obtain; the cast embracing the wrist, elbow, shoulder and thorax. Before putting on this case, a dressing is placed on the arm about the size necessary to protect the wound after operation. During the application the wrist is held in mild hyperextension so that it will be retained in this position, the extensor muscles of the forearm being thus relaxed and not stretched. The elbow is put up in the flexed position with the arm rotated inward so that the forearm rests across the front of the body (Fig. 1). If there has been trauma to the musculospiral nerve and consequent paralysis, the muscles will regain their power more quickly on the restoration of a path for nerve impulses, than if the muscles are allowed to remain stretched. After the plaster has hardened sufficiently to allow cutting with a sharp knife, the cast is split into anterior and posterior halves which can be readily applied and held in place by adhesive strips after the operation is completed. This method is resorted to, since it is rather difficult to apply a good plaster spica to the shoulder with the patient asleep. Fig. 1 shows a cast which was applied two weeks after operation, and was worn by the patient for four months.

An inlay graft, as being more anatomical, is to be preferred. The sliding method is not practical, since in order to obtain a piece large enough very good exposure is necessary and consequent trauma is produced to the muscles and nerves. The graft is obtained from the flat internal surface of one of the tibias, preferably by the circular motor-propelled saw. It should be long enough to extend well into the sound bone of the ends of the shaft. A graft 6 inches long by ½ of an inch wide is the ordinary size desired. A transplant that is too small causes more failures than any other one factor in bone grafting operations. The failures in our cases may be traced to two causes, too small a graft and inadequate fixation post-operatively and during convalescence. To hold the graft in the trough prepared for it double strands of number 2 chromic catgut or single strands of kangaroo tendon are used, placing them around the humerus by aid of a ligature carrier. The wound is closed with silkworm and horse-hair. The patient is placed in the split spica cast, which is strapped together with adhesive plaster. At the end of two weeks the stitches are removed and a new plaster-of-Paris cast applied. An opening is left over the wound if it is necessary to use further dressings. A brief history of each case is given herewith.

CASE I (70556. X-ray 16295).—J. R. B., male, aged twenty-eight, examined by us July 13, 1912. One year prior to examination, at which time there was no union, a fracture had been sustained of the middle third of the left humerus. The operation was performed July 17, 1912, and a three-inch plug inserted by the intramedullary method. A Lane plate and a retentive splint, merely extending from the elbow to the shoulder, were used. At the end of one year there was no union. On October 23, 1913, a second operation was done, the Lane plate removed, an inlay graft inserted, and a plaster-of-Paris spica applied. A mild infection occurred and persisted until December, 1914, when the transplant was removed at the patient's home. Union was firm at this time and the discharge from the sinus ceased within five days.

Following the first operation a musculospiral paralysis developed, due to excessive traction at operation. Since it was certain that the nerve had not been severed, a good prognosis was given, but it was four months before there was any return of power and one year before there was complete restoration.

CASE II (50611. X-ray 11299).—R. W., male, aged sixty, was examined on March 24, 1911, four months after the fracture had occurred. There was no union at this time. Lane's plate and an ivory intramedullary plug (C. H. Mayo[6]) were used with resulting non-union and infection. December 28, 1912, the metal plate and screws were removed and a bone plug inserted in the medulla in spite of a chronic low grade infection. Later the bone plug was thrown out because of the infection, and the patient lost sight of. At this time union was firmer than at any previous time. This history calls attention to the fact that a patient sixty years of age is not a particularly suitable case for bone transplantation.

CASE III (90547).—H. L. B., male, aged forty-six years, examined August 22, 1913. Eight months previously he had sustained a compound fracture of the humerus and the elbow became ankylosed. August 25, 1913, an intramedullary bone plug was introduced. The transplant broke in two months, the result of poor fixation. No plaster-of-Paris spica was used, and the ankylosed elbow in the extended position made it very difficult to control the arm. This patient has not been traced.

CASE IV (89929).—G. A., male, aged fifty-nine years, examined August 13, 1913. He had non-union of the lower third of the right humerus of 2 months' duration. There had been a compound fracture of the humerus, followed by marked limitation of motion in the right elbow. September 2, 1913, an intramedullary plug was inserted. The plaster-of-Paris spica was not used and the fixation was faulty. A stiff elbow complicated our efforts to control. November 27, 1915, the patient reported that there was no union. The poor fixation and the patient's age were prob-

ably responsible for the failure. Röntgenogram showed that the transplant had absorbed.

CASE V (92214).—I. B., female. aged eighteen years, examined September 17, 1913. Fracture of the lower third of the left humerus. Ten weeks after the fracture there was no union demonstrable. October 10, 1913, a bone plug was inserted, as an inlay in the upper fragment, and in the medullary cavity of the lower fragment. A plaster-of-Paris spica cast was used and firm union resulted in 3 months.

CASE VI (96248).—J. M., male, aged forty years, examined November 29, 1913. Ununited fracture of the middle third of the right humerus of thirteen and a half years' duration. All this time the arm had been used, the patient being a laborer. The röntgenogram (Fig. 2) shows the bone to be of normal density and not thinned out as are most of the fragments in ununited fractures. A typical flail-joint was present. The man came for consultation because of a musculospiral paralysis, which had been partial for five months, and complete for three months. He was operated on December 4, 1913, by a combined intramedullary and inlay method. One-half of the transplant was used as a plug and the other half was placed as an inlay in a trough prepared for it. The normal density and properties of the fragments warranted the use of a short graft. The musculospiral nerve was not traced or touched as it was thought the paralysis was due to the irritation produced by the rubbing of the fragments. There was no callus present to cause definite pressure. A plaster-of-Paris spica was applied and in 3 months there was firm union (Fig. 3) with full function of the musculospiral nerve. In four months from the time of the operation union was firm and the man was handling heavy timber in a lumber yard (Fig. 3).

CASE VII (101653).—M. H., male, aged thirty-eight years, examined March 4, 1914. Ten months before being operated on at the Mayo Clinic, this patient sustained a compound comminuted fracture of the lower third of the left humerus, followed by severe infection. At his home, after the wound had healed, metal plates were applied but non-union persisted. When examined by us March 4, 1914, four months after the plating operation, there was no union and marked restriction of motion of the elbow, possibly 10 degrees being permitted. Musculospiral paralysis was complete. March 12, 1914, we first forcibly flexed the elbow to about a right angle and then transplanted an inlay from the right tibia after removing the metal plates. The musculospiral nerve was not traced as it was thought that by securing union and reëstablishing stability, the nerve would regain its function. The bone-graft used was only three and a half inches long and this accounts for the slow union (ten months). A longer graft would probably

FIG. 1.—Spica plaster-of-Paris case.

FIG. 2.—Non-union in humerus of thirteen and one-half years, duration. Note the normal density of the fragments.

FIG. 3.—Firm union three months after operation.

FIG. 4.—Non-union one year after wiring.

FIG. 5.—Long inlay transplant extending well up into healthy bone. Union secured.

have hastened the union. A plaster-of-Paris spica was applied. At the end of six months the union was apparently solid, but a plaster-of-Paris spica was worn for four months longer, when union was quite firm. Musculospiral paralysis persisted without noticeable gain and, on September 4, 1915, the nerve was explored and a separation found three inches above the elbow. The ends were freshened and sewed together with chromic catgut and silk, the anastomosis being surrounded with fascia obtained from the right thigh. An arthroplasty on the elbow will be done after the return of function to the nerve if no more motion returns in the interim. (Examination November 23, 1915, two months after operation, revealed no signs of return of function in the musculospiral.)

CASE VIII (104394).—J. H. F., male, aged fifty-three years, examined April 16, 1914, one year after having sustained a fracture of the right ankle and the right humerus. The fracture of the humerus was wired at his home, but, riding on a train six weeks later, which was wrecked, the right arm and right ankle were again injured. Following this musculospiral paralysis slowly came on. Four months later at his home the musculospiral nerve was traced and freed from all adhesions. At the time of our examination a fracture ununited in the middle one-third of the humerus (Fig. 4) was present and musculospiral paralysis was complete. On May 21, 1914, the fragments were exposed and the wire removed. An intramedullary plug was used and many bone chips placed about the site of the fracture. The bone transplant was not more than 3 inches in length. A plaster-of-Paris spica was applied. The musculospiral nerve was not traced. No union resulted although the cast was faithfully worn. On March 4, 1915, by the inlay method, we transplanted a piece of bone from the tibia 7 inches long (Fig. 5). August 27, 1915, his physician wrote that firm bony union had taken place. Musculospiral paralysis was still present.

CASE IX (119754).—C. B. W., male, aged thirty-six years, clerk, examined November 25, 1914. One and one-half years before he had fractured both tibias, both os calces and the right humerus. All the bones had united except the humerus, which was fractured in the lower third. This had been wired and plated at his home (3 operations), but no union resulted. December 5, 1914, the ends of bone were exposed and Lane plates removed. An intramedullary transplant was inserted and many small pieces of bone placed about the line of the fracture. A plaster-of-Paris spica was applied and worn for six months, but no union resulted. Again, May 5, 1915, he was operated on and the inlay method used. Two weeks after the operation, the split-cast was removed and a new one applied which was worn for five months, when union was found to be firm.

CASE X (107886).—L. R. H., male, aged thirty-three years, farmer, examined June 11, 1914. Two years before this man sustained a simple fracture of the left humerus; at 12 weeks there was no union, and in June, 1914, an intramedullary plug was put in by his home physician. No union resulted. On June 12, 1914, we applied a plaster-of-Paris spica, which was worn for 6 months, but no union was demonstrable on its removal. December 10, 1914, a large inlay graft was inserted and a plaster-of-Paris spica applied. Five months later firm union was demonstrable both clinically and by the röntgenogram.

Discussion.—In the treatment of these 10 cases a technic has been developed which if carefully carried out will give a high percentage of successes. That an exact technic is necessary is shown by the high percentage of failures which have occurred by the use of a small graft and a more or less haphazard after-care.

In 9 cases (excluding the case in which there had been non-union for thirteen and a half years) the average duration of non-union before transplantation of bone was twelve and a half months. The average age of the patients was forty-one years; the oldest sixty and the youngest eighteen years. But one woman (aged eighteen) was operated on. In 6 the right humerus was fractured, in 4 the left humerus. In 4 the fracture was in the lower one-third, in 6 it was in the middle one-third. Five had been operated on before coming to our clinic. There was an infection present in one at the time of the first operation and in another at the second operation. In four union was obtained by the first operation. In three a second operation was necessary. In two cases we were unable to obtain data as to the ultimate result; in one we know there has been no union; these two cannot be definitely reported upon except to say that so far as is known the results in our early cases were not satisfactory. They may or may not have ultimately attained union. Musculospiral paralysis was present in 3 at the time of our examination and operation. In one a short time before our examination and operation, the nerve had been traced and was said to be intact by the patient's home surgeon. Union of the bone had resulted from our operation, but now, more than one year afterward, there is no return of function in the musculospiral nerve and doubtless it should again be explored. One patient, a brakeman, had the paralysis at the time of the operation and we had intended tracing the nerve, but the implantation of the graft took so long, due to many adhesions and fibrous tissue caused by three previous operations, that no attempt was made to trace the nerve until some time later, when it was found severed. The ends were freshened and placed in a fascial tube made from the fascia lata of the thigh.

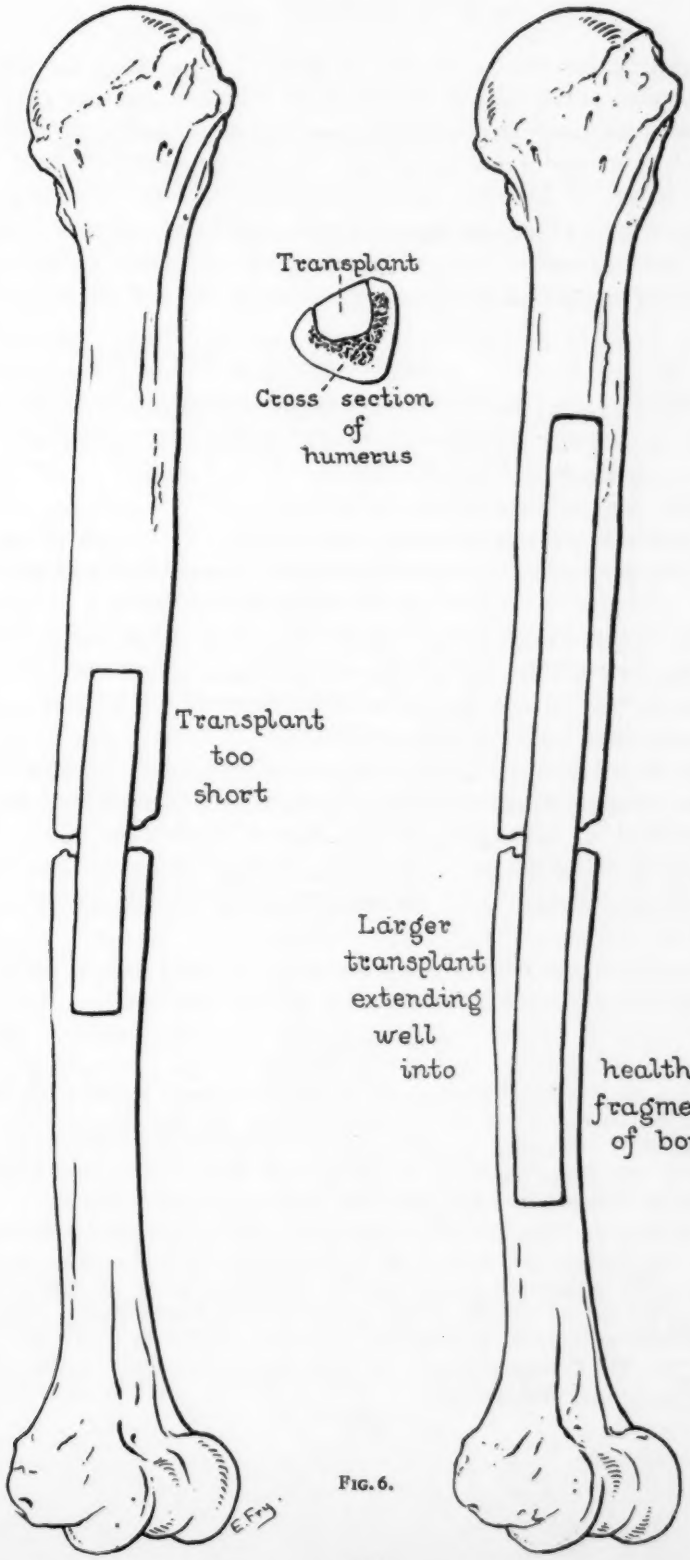
Transplant
Cross section of humerus
Transplant too short
Larger transplant extending well into
healthy fragments of bone
E. Fry

FIG. 6.

The result cannot yet be stated. In both of these cases the primary musculospiral paralysis was produced at the time fracture occurred. One case of ununited fracture of thirteen and a half years' duration had a secondary musculospiral paralysis. By the time the bone was completely united the function of the nerve was normal. In one of our early cases by too free and vigorous retraction at operation a paralysis of the musculospiral was produced which remained complete for four months and partial for one year. There is now full function in the arm.

CONCLUSIONS

1. The transplant must be as large as is practical (6 inches by ½ inch or larger). It must extend well past the thinned decalcified ends into the hard, healthy bone beyond (Fig. 6).

2. The inlay is the method of choice.

3. Adequate post-operative fixation is essential. A split plaster-of-Paris spica prepared a few days before the operation can be fastened on with adhesive strips immediately after the operation is completed, thus eliminating the difficulty of applying the spica and the danger of disturbing the graft thereby. Two or three weeks later when the wound has healed and the stitches have been removed, a new cast can be applied carefully with the patient sitting up.

4. By removing the bone-graft from the flat internal surface of the tibia, the strong crest of the bone is left to perform its important weight-bearing function. The patient may be allowed to walk in from 12 to 14 days. At this time the blood clot filling in the bony defect has become sufficiently organized so that no hemorrhages will occur on the use of the leg.

5. A properly applied spica cast may be comfortably worn for 3 months, when in all probability union will be complete.

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OSTEOMYELITIS INVOLVING THE HIP-JOINT *

A CONDITION HERETOFORE ERRONEOUSLY DESIGNATED ACUTE EPIPHYSITIS

By James E. Moore, M.D.

of Minneapolis, Minn.

PROFESSOR OF SURGERY IN THE UNIVERSITY OF MINNESOTA

"Acute suppurative inflammations affecting the joints of young children are grouped under the following titles: Acute suppurative arthritis of infants; epiphysitis; acute osteitis of growing bones.

"An acute suppurative synovitis occurs in children under four years, which Krause has found to be due to the presence of streptococcus pyogenes. It may be excited by injury or it may occur with the exanthemata. It gives the symptoms of a phlegmon, and usually yields promptly to free incision and drainage. It attacks the hip-, knee-, shoulder-, and elbow-joint.

"There is another disease usually placed under this heading that is of a graver character than the above-described disease, and which begins at or near the epiphyseal line. It occurs in the hip-joint, and has been well described by Macnamara under the name 'epiphysitis.' *It is an acute osteomyelitis.* The symptoms all point toward an acute inflammation of the hip-joint. There is excruciating pain and high temperature, followed by deformity and swelling. The joint is so deep-seated that redness does not occur. The symptoms are much more acute than in tubercular osteitis of the hip. There is apt to be an early separation of the epiphysis, with rapid destruction of the hip-joint. The treatment consists of free incision and drainage. The opening should be made large enough to admit a finger, in order to ascertain whether the epiphysis is separated or not. If separation has taken place, the epiphysis should be removed at once. This is a grave disease, but with prompt treatment the writer has seen cases recover that were seemingly beyond help."

This description was published by the writer eighteen years ago, and is just as good now as it was then. It should be observed that at that time the writer did not accept the commonly accepted term "epiphysitis" but pronounced it an acute osteomyelitis. Constant observation since that time has only confirmed the opinion then expressed, that this disease does not begin in the epiphysis but does begin

* Read before the Western Surgical Association, December 17, 1915.

in the neck of the femur, and one case cited goes to prove that it may even begin in the shaft of the femur. The epiphysis is the favorite site for attack by the tubercle bacillus, but there is no evidence whatever that this is ever the original point of infection from pyogenic germs. The reason the name " epiphysitis," originally suggested by Macnamara over twenty-five years ago, has been and still is in vogue is that osteomyelitis is quite rare in this location and the diagnosis is not made until the joint has become involved and the epiphysis has separated from the neck. The epiphysial line is the point of least resistance and soon gives way and the epiphysis becomes separated. When the joint is opened the floating epiphysis at once attracts the operator's attention and the original opening into the neck of the femur can be easily overlooked. Some reported cases of extremely rapid recovery after excision of the hip for tuberculosis have not been tuberculosis, but have been cases of osteomyelitis with separation of the epiphysis. Unfortunately, the infection in these cases is usually so severe that unless drainage is promptly established the patient loses his life; but in the exceptional case the infection is less virulent and nature may establish drainage by rupturing the abscess through the skin. The separated epiphysis acts as a foreign body and sinuses remain open. Deformity takes place, and the case assumes the appearance of the common tubercular hip, so that it may not be possible to make a differential diagnosis until an operation has been performed and a careful bacteriologic examination has been made.

Of the many cases of osteomyelitis involving the hip-joint seen by the writer, only four will be presented as proof of the correctness of the statements made in this paper.

CASE I.—A boy six years of age was admitted to the University Hospital with a very high temperature and in a semicomatose condition. His right limb was everted and the thigh very much swollen. The attending physician stated that the trouble began a few days before his admission, with high fever and very severe pain in the hip. A diagnosis of acute osteomyelitis was made and an incision made on the outer aspect of the thigh, as the boy's condition precluded any radical procedures at that time. Drainage was very profuse and rapid improvement followed, so that in a few days the patient was anæsthetized and the original opening enlarged. By means of this opening a finger could be passed through an opening in the lower wall of the capsule of the hip-joint. The joint was then opened. The epiphysis was found separated and the whole neck of the femur destroyed,

so that it was necessary to make a formal resection of the hip-joint, after which improvement was rapid. The epiphysis was not much eroded, but the neck of the femur was broken down and necrotic, showing that the latter was undoubtedly the original seat of infection.

CASE II.—H. M., age nine years, was admitted to the University Hospital August 4, 1915, under a diagnosis of acute articular rheumatism. Gives a history of having had a fall one month before admission, from which she suffered very little. Two weeks before admission began to have pain in the joints, was nauseated and vomited. Since that had repeated chills. Most of the pain was in the upper part of the left femur. She gave the appearance of being profoundly septic. She was first admitted to the Department of Pediatrics, where it was found she was suffering from an empyema of the left side, and an abscess just below the left breast. She was transferred to the surgical service on August 7, when she was found to have in addition to her empyema an osteomyelitis of the upper third of the left femur and some swelling of the left wrist, and an abscess in the anterior chest wall. A section of one rib was removed from the axillary line and drainage of the pleural cavity established. The abscess of the chest wall was drained. Very little anæsthetic was given, operation was performed in a very few minutes, and the patient seemed no worse for it. Her temperature dropped immediately, but she still was very ill, giving evidences of profound sepsis.

A definite focus in the upper third of the left femur could be located with very little difficulty from the periosteal tenderness. There was some swelling of the hip-joint, but with care the joint could be moved without giving pain. There was flexion of the hip-joint. It was impossible to determine which was the primary focus, the femur or the empyema, but very probably the former. Notwithstanding the drop in temperature her condition was so low that we did not dare give an anæsthetic for operation upon the femur. When she was admitted her temperature was 103½°, pulse 160. After the operation her temperature dropped immediately to normal; pulse remained at 130; leucocytes 27,000; polymorphonuclears 72 per cent. On August 16 she had a sudden effusion into the pericardium and died.

Skiagraphs had been taken and showed breaking in the periosteum of the left femur, but nothing more.

At postmortem a large quantity of bloody serum was found in the pericardium. The empyema was practically well. On opening the left thigh an abscess was found, beginning opposite the point where the focus had been located clinically, separating the

periosteum from the inner side of the femur, extending up to the under side of the joint where it perforated into the joint, and the joint was full of pus. The femur was split longitudinally, showing the epiphysis healthy, but the focus beginning in the medulla of the femur extending upward. Had this patient lived longer the epiphysis would undoubtedly have become separated, and this might have been pronounced a case of acute epiphysitis by a careless observer.

CASE III.—T. S., aged twelve years. Case No. 6594. Admitted to the University Hospital July 20, 1915.

Ten or twelve days before admission she complained of pain in the right hip and pelvis, with temperature from 100° to 104°, but could walk about. She was admitted with temperature of 100.9° and pulse of 126; leucocytes 22,000; polymorphonuclears 65 per cent. Patient had slight flexion of the right hip. Complained of some pain in hip, thigh and pelvis. There was slight swelling over the right hip-joint. The slightest motion in the joint caused intense pain. Pressure made directly over the joint from front and back elicited excruciating pain. There was no tenderness on pressure in the femur.

A diagnosis of acute osteomyelitis of the neck of the femur was made. The writer believed that this was a typical case with an early diagnosis and one well fitted for the demonstration of the correctness of his views. So he requested one of the junior staff to operate upon it exactly as he would upon an acute osteomyelitis in any other location. Dr. Strachauer opened the hip-joint from the front, found some serum in it, but it looked comparatively healthy. The neck of the bone was so soft that an instrument could readily be pushed into it. A small opening was drilled directly into the neck of the femur and a drainage tube introduced into this opening, and the capsule of the joint closed around it. There was no flow of pus following the opening into the bone, but from the subsequent history of the case no one can doubt that this was the original focus of infection. We all know that our most brilliant results from operations for osteomyelitis are in those cases in which the diagnosis and treatment have been so early that little or no pus has been formed, but in which the symptoms have been relieved by the operation.

The *following day her temperature dropped to normal,* and varied from that on between normal and 99½°, disappearing entirely in the course of a few days. The drainage tube was removed on the tenth day. On August 4 the wound was completely closed, the joint freely movable and free from pain. On August 16 she was up, walking on crutches. Pain was relieved

immediately after the operation, and she was sitting up in a chair on July 30. Was first allowed to bear weight on the joint August 19. She was finally restored to health with a healthy, normal hip-joint.

The infection in this case was not so virulent as in the average case, which accounts for the small amount of destruction that had taken place when the diagnosis was made, but can anyone familiar with the ravages of osteomyelitis doubt what the result would have been had the case gone on without proper treatment? The diagnosis should have been easier had the infection been more virulent.

CASE IV.—This case illustrates the fact that inflammation of the neck of the femur may be secondary to osteomyelitis elsewhere, and that it may be subacute in character. A boy twelve years old was admitted into the University Hospital with a severe osteomyelitis of the left tibia, which was operated upon promptly, after which he began to improve rapidly. After a few days he began to complain of discomfort in the right hip. There was no decided rise of temperature and the pain was not severe. The symptoms were so slight that too little attention was given him until we noticed that the limb was everted and shortened. The joint was opened and found full of pus. The epiphysis was separated and the neck of the femur was necrotic, so that a formal resection of the hip was made, after which he made a speedy recovery.

It is only with an earnest desire to bring out the truth that this case is reported, for it is not very creditable to us. We should have made the diagnosis early and drilled into the neck of the femur and saved the boy's hip. Our only excuse is the remarkable mildness of all the symptoms.

It is very evident that when Macnamara suggested the name acute "epiphysitis" he meant the term to apply to the whole neck of the femur, but the universal application of the term epiphysis to that portion of the head of the hip beyond the epiphysial line has led to an unfortunate misunderstanding and much bad surgery. The term "epiphysitis" should therefore be abandoned. The name osteomyelitis as applied to pyogenic infection of the neck of the femur in this paper is incorrect, because the neck of the femur has no medulla, but is used by the writer to emphasize the fact that acute pyogenic infection of the neck of the femur in growing bone does occur, that it resembles osteomyelitis in every particular and that it demands the same prompt treatment. It is even a greater menace to human life than osteomyelitis, because it is more difficult to diagnosticate, and when the original seat

of infection breaks down the opening is into the hip-joint instead of the soft parts. These cases are not so rare but that they come under the observation of every surgeon, and they demand more careful consideration than they have received heretofore. They offer a field for brilliant, life-saving surgery. When the diagnosis is made very early, before the joint is involved, the operation originally suggested by Macnamara and later advocated by Huntington should be performed. An incision should be made over the great trochanter, and an opening drilled through the trochanter and the centre of the neck of the femur in its long axis until the seat of infection is reached. When the diagnosis is not made until the joint is involved it is better to enter the joint directly from the front. The only reason the Macnamara operation was not performed in Case III is that the diagnosis was questioned by some members of the staff and we wanted to see just what we were doing.

When the late operation is done a formal excision should not be made unless the neck is completely necrotic, but as much of the neck should be preserved as possible for future usefulness.

While the writer advocates the abandonment of the term "epiphysitis" he has no new name to offer. The term "acute suppurative arthritis" is objectionable because there are many cases of acute suppurative synovitis in which the bone in involved, and they are not nearly so serious. Would it not be well to revive the old term "acute osteitis of growing bone"?

THE LEGAL RESPONSIBILITY TO THE SURGEON AND PRACTITIONER WHICH THE USE OF THE X-RAY INVOLVES

By Ellsworth Eliot, Jr., M.D.
of New York City

In December, 1912, an experienced surgeon was the defendant of a malpractice suit in which the plaintiff recovered a verdict of over $11,000, on the ground that the care of a simple fracture of the lower part of the shaft of the femur, the result of an automobile accident, had not received due and proper attention. Four weeks after the accident the patient was seen in consultation by the writer, and, at a considerably later period, in fact after a plating operation by another surgeon, the patient was examined by the late Dr. Bristow. To us both, subsequently associated in the defence of the action in court, the importance of the case and the fact that such a verdict, if sustained on appeal, would make the physician or surgeon hesitate to undertake the treatment of cases of this character, seem to warrant the presentation of its chief surgical and legal features in the hope that this Association might take some action that would, in a measure at least, protect the surgeon in future from unwarrantable suits of this character.

For this task Dr. Bristow kindly volunteered and had prepared or was preparing a paper with the title already cited when his unexpected and most unfortunate death occurred.

The importance of the matter was such, however, that notwithstanding the short notice, the writer was impelled to take Dr. Bristow's place in order that the question might be presented to this Association for discussion without further delay.

The testimony showed that after the accident the patient was conveyed to the nearest suburban hospital in an ambulance, the fractured thigh having been placed in temporary splints; that, at the end of forty-eight hours after the shock had subsided, the fracture was reduced by the defendant under a general anæsthetic and placed in a Buck's extension apparatus; that, at the end of the fourth week, the writer found the fragments imbedded in abundant callus with no sign of either axial or angular deformity and with a shortening that did not exceed one-half an inch; that, near the end of the fifth week, the union being sufficiently advanced to permit of active rotation of the thigh, and no false point of motion being elicited, the leg was put in a plaster-of-Paris splint.

The patient was then gradually allowed out of bed on crutches with adequate support to the thigh and with strict injunctions to bear no weight on the affected side, a nurse being in constant attendance. At that time the shortening did not exceed one-half an inch.

From this time until her discharge from the hospital, nine weeks after the accident, the testimony was uneventful with the exception of one fact. At the eighth week the plaintiff declared that a slight slipping of the crutch caused her to lose her balance, and that, although the nurse prevented a fall, the patient involuntarily placed a slight amount of weight on the affected side. The resultant pain was so slight and of such short duration that the incident was not reported to the defendant by either the nurse or the patient. In addition, the testimony of the defendant showed that, contrary to this strict injunction, the patient, at about this same time, had made an effort to get out of bed unaided by the nurse and in her absence and had felt a severe pain at the point of fracture. It was on the following day when the defendant, on measuring the thigh, found a sudden increase in the shortening to almost one inch, that, in answer to his question, the patient reported the above incident. Notwithstanding this sudden increase in the shortening the surgeon found no false point of motion and concluded that there had been some displacement of the fragments without actual recurrence of the fracture. In the course of the trial the conversation above cited was indignantly denied by the plaintiff.

At the end of the ninth week and at her own urgent and oft-repeated request, the patient was discharged from the hospital and referred to her own family physician in New York, with strict injunction to bear no weight on the affected side until four weeks later or until the expiration of the thirteenth week after the accident.

The family physician testified that on several visits for minor ailments before the expiration of this time, he had examined the fractured thigh and had noticed some irregularity but no false point of motion. He also testified that he was present, when, three weeks after leaving the hospital, patient made an effort to bear the weight of the body on the affected side and experienced such terrible pain at the point of fracture that the experiment was not repeated. An X-ray, taken four weeks later or sixteen weeks after the accident had occurred, showed an old oblique fracture of the lower end of the shaft of the femur. The line of fracture made an angle of about 20 degrees with the shaft, and although in the anteroposterior plane the alignment was perfect, in the lateral plane the fragments appeared displaced to such an extent that the posterior aspect of the upper appeared to be in touch with the an-

terior aspect of the lower fragment. The fragments seemed firmly united with callus, there was no false point of motion, and the shortening did not exceed one inch.

Without the knowledge of the defendant a third surgeon saw the plaintiff in consultation four and one-half months after the accident and advised an operation in which the fragments were exposed, their ends freshened by the removal of five-eighths of an inch from each fragment and after alignment they were secured in the usual way by plates. An X-ray, after union had taken place, showed some angular deviation notwithstanding the plates which, in the opinion of the plaintiff's physician, accounted for at least one-quarter of an inch of the final shortening. At this stage the patient had been examined by Dr. Bristow, and his testimony as well as that of the plaintiff's physician showed that the final shortening did not exceed two inches.

The removal of five-eighths of an inch from either fragment together with the one-quarter of an inch additional shortening due to the final angular deviation proved conclusively that prior to the operation the shortening could not possibly have exceeded one inch.

It was further shown by the testimony that, three weeks after the accident, at the suggestion of the defendant, an effort was made to secure an X-ray with the hospital machine, but the result was unsatisfactory as the machine proved to be out of order, notwithstanding an attempt was made to put it in repair. It was also shown that several months would be required before the machine could have been placed in serviceable condition. The defendant was in no way held responsible for this failure as the machine was the property of the hospital.

No further attempt was therefore made to utilize the hospital apparatus and no suggestion was made by either the defendant or the plaintiff to call an X-ray expert from New York. It was in lieu of an X-ray that a consultation was suggested by the defendant and accepted by the plaintiff. In the course of the trial the medical testimony of the plaintiff admitted that the treatment, as conducted by the defendant, was a proper and recognized form of treatment and that the failure of the defendant to suggest the calling of an X-ray expert constituted the sole basis for the charge of neglect.

In his charge to the jury the judge called attention especially to the fact that the defendant had failed to suggest the taking of an X-ray, after the failure of the hospital apparatus, by a specialist from New York (35 miles distant), and, in the opinion of the defendant's counsel, it was the special prominence given this fact that led to the unfortunate verdict.

The first question suggested is as follows: With firm union between the fragments of a broken shaft of the femur and with a shortening of an inch or less, is an operation indicated because, on the first attempt to bear the weight of the body on the affected side, the patient experiences excruciating pain?

The question is easily answered. The opinion would, I am certain, be unanimous that more or less severe pain on the first attempt to bear the weight of the body on the affected side after a fracture of the shaft of the femur had firmly united, would not be unusual, especially in patients who had sustained or were still suffering from some severe mental shock, and that only the persistence of severe pain, unabated, after repeated attempts at walking would indicate operative interference. That displacement in itself is not a cause of pain nor a barrier to union is frequently demonstrated by patients in whom a shortening of three inches or even more from extensive overriding of the fragments has not prevented union sufficiently strong to bear without pain or other inconvenience than a limp the superimposed weight of the body. It must be generally conceded that any fracture of the shaft of the femur in which firm union takes place with permanent shortening not exceeding one inch is a satisfactory result and that instances in which some shortening is not observed are very rare. A moderate shortening in itself clearly indicates a corresponding overriding or displacement due to the failure to counteract, by the usual forms of extension and counter-extension, the stronger pull of the powerful muscles of the thigh. As a matter of fact, this difficulty has led to the devising of more efficient methods of powerful traction applied directly to the lower fragment itself as well as to the advocating by Lane and others of the plating of every fracture of the shaft of the femur where the general condition of the patient permits.

The question of negligence based on the failure of the attending physician or surgeon to suggest or advise the taking of an X-ray photograph in cases of simple fracture, presents a most interesting as well as a most important topic for discussion. It is peculiarly important in that, prior to the case reported in this paper, there has been no record in either medical or legal literature in which a plaintiff has been awarded damages on such an allegation. The question may be discussed most advantageously from the medical as well as from the legal point of view. The medical point of view is best approached by a brief résumé of the history of the X-ray. Shortly after its discovery some form of apparatus formed a part of the office equipment of many successful practitioners throughout the country. After a com-

paratively short time experience taught that the care, the development of its operative technic, and in short the intricate detail necessary to procure satisfactory results precluded its general use, and another specialty was born with the result that many costly X-ray machines in the possession of the busy practitioner were quickly consigned to the scrap heap.

Ranking from this time with the specialties, those engaged in it formed a group of which the functions were quite analogous to the functions of special consultants in other branches of medicine. Under such circumstances and with such functions their services in aiding the diagnosis and treatment of cases of fracture were essential only when the bone at the point of fracture was so deeply seated that accurate diagnosis was impossible, or, if diagnosis had been made, when the excessive thickening of the overlying soft parts made satisfactory reduction of the fragments difficult. Under the conditions the assistance of the röntgenologist became of great value. Is, then, the function of the X-ray specialist to be extended to those cases of fracture in which the attending surgeon, by methods of diagnosis and reduction evolved through centuries of observation and investigation, can be reasonably certain that the fragments are in such apposition that satisfactory union may be expected? The writer believes that this is no more essential than it is to call a special consultant in every case of pneumonia, appendicitis, or strangulated hernia. Is not, as a matter of fact, the consultant called more frequently at the request of the family than with any hope of benefit from his advice? And is it not with the same spirit, the spirit of self-protection, that, in cases of fracture or dislocation, an X-ray is suggested when the surgeon is morally certain that the fragments are in apposition or that the dislocation has been successfully reduced? Is not the fear of litigation in the event of non-union or other unfortunate result, in no way the fault of the surgeon, a very strong incentive for generally advising an X-ray irrespective of the location of the fracture? The writer believes that these questions must be answered affirmatively and that it is time to establish the principle that the use of the X-ray, although in many instances most desirable, yet in many cases is not indispensable to the proper treatment of a fracture. That such a principle should be established is all the more essential in view of the fact that, having become a specialty, the use of the X-ray is frequently inaccessible in many cases of fracture. Should any method of diagnosis or treatment be regarded as indispensable when it is not generally applicable? Should the physician in a scattered community, remote from an X-ray laboratory, be subject to litigation because he

fails to advise or suggest the need of an X-ray? This question is best answered by quoting the legal statute of the State of New York as follows:

"A physician is bound to have a reasonable degree of skill and learning, and having that reasonable degree of skill and learning, he is bound to exercise it with reasonable care, and what his reasonable care is, is that care which the ordinary careful and prudent practitioner usually ordinarily exercises in the locality in which the physician is practising."

In view of this statute the treatment accorded by the physician must be that ordinarily exercised in the community of which he forms a part. In almost no community outside of large cities are efficient X-ray machines found, and even in large cities the smaller hospitals are not always provided with adequate X-ray apparatus. In the community in which the alleged malpractice occurred no X-ray machine was in working order, but this fact did not prevent the judge from connecting this suburb, although 35 miles distant, with New York proper and thereby compelling the defendant to measure up, both in knowledge and in efficiency, to a standard which did not obtain in the community in which he lived.

Finally, is the physician or surgeon liable to damages because of his failure to advise a consultant? Irrespective of the nature of the disease or trauma and irrespective of the locality in which it occurred, how endless would be the resulting litigation if such omission constituted neglect. Whether the object of such a suggested consultation were to aid in diagnosis or whether to suggest a way to prolong the life of one hopelessly ill, the frequency of examples of such neglect would be beyond computation. The writer firmly believes that arrangements for consultation are made at the request or suggestion of either the surgeon or some member of the patient's family, and that in the latter event the fact that such a consultation was not deemed necessary and therefore not suggested by the surgeon can in no wise be construed as neglect.

Lack of time precludes the consideration of the many uncertainties connected with the interpretation of the X-ray picture itself. It is a well-known fact that on exploration a condition may be found essentially different from that which the X-ray seemed to indicate and, similarly, deformities may be either exaggerated or minimized by the manner in which the photograph is secured. Space also precludes the consideration more minutely of the question of the inaccessibility of the X-ray owing to the distance from large centres, and a most important fact, that even in large centres some hospitals are conducted without the

advantages of an X-ray apparatus, may not have been duly emphasized. Suffice it to say that after careful consideration of the many phases of the question, although in many instances a most important and valuable aid in the diagnosis and treatment of fractures, the use of the X-ray must not be judged indispensable, and the neglect to advise its use should in no instance constitute a basis for the recovery of damages. Should such a principle prevail the time is not far distant when the prospect of litigation will prevent those most competent from undertaking the care and treatment of cases of this character.

TRANSACTIONS
OF THE
NEW YORK SURGICAL SOCIETY

Stated Meeting, held December 8, 1915

The President, Dr. Charles N. Dowd, in the Chair

OPEN REDUCTION OF FRACTURED EXTERNAL CONDYLE OF HUMERUS

Dr. William Darrach presented a boy, five years of age, who was brought to the Presbyterian Hospital on November 11, 1914, for an injury sustained one week previously. The elbow was slightly swollen, especially on its outer aspect, where a bony mass could be felt just beneath the skin. This mass was freely movable in an anteroposterior direction, but only slightly up and down. It was not tender and presented a flat subcutaneous surface. Extension was possible to 175° and flexion to 80°. Pronation and supination were normal. X-ray examination showed the fragment of bone to consist of the capitellar centre, the epiphysial line plus a thin shell of shaft.

On the following day a curved incision was made over the antero-lateral aspect of the elbow and deepened through the fascia along the inner margin of the brachioradialis. The brachialis anticus was then split a little to the inner side of the musculospiral nerve and the lower end of the bone exposed. The fractured surface of the lower humerus presented but the fragment could not be located until a gauze-covered finger was introduced. The fragment was then found to the outer side but still within the joint and still attached to the structures inserting at the external epicondyle. The line of fracture had passed through this point downwards and inwards, reaching the joint line just within the outer trochlear margin. By pressure outside with the aid of the leverage action of an elevator, the fragment was finally pried into place. As the elbow was flexed, the radial head seemed to hold the fragment in good position and the wound was closed with catgut for the deeper tissues and silk for the skin. The elbow was immobilized at 60° with a starch bandage. His highest post-operative temperature was 100° and he left the hospital 9 days after operation. The boy developed chicken pox soon after leaving the hospital and was lost track of for a while. His motion returned rather slowly but at the end of a year he seems to have a normal elbow. The X-ray shows

the fragment in place and there is no apparent interference with the normal growth of the lower humerus.

OPEN REDUCTION OF FRACTURE OF THE CAPITELLUM

Dr. William Darrach presented a man, thirty-five years of age, who on June 9, 1915, had slipped on a sidewalk and fallen first on his palm and then on his elbow. There was considerable pain referred to the front of the elbow, made worse by extension. Pronation and supination were a little limited and flexion was stopped at 80°. He entered Presbyterian Hospital and was operated on 6 days after his injury. With the elbow flexed to 90° an incision was made from a point a little above the external epicondyle downward and forward for a distance of three inches. The extensor aponeurosis was split and the joint cavity opened. The radial head and the fractured surface of the humerus presented. The capitellar fragment was located after some difficulty lying in front and above its normal site. It was removed, its broken surface wiped free of new-forming tissue, washed with hot saline and replaced in the normal site after the humeral surface had been freshened. The line of fracture had passed from above and in front, downward and backward, so that as the forearm was flexed to 90° the radial head seemed to hold the fragment in good position without any internal appliance. The deeper tissues were approximated with chromic gut, the fascia with plain gut and the skin with silk. The arm and forearm were dressed and the elbow immobilized at 90° with a plaster bandage. The wound was dressed on the sixth day and the stitches removed. Primary union. The plaster was removed after three weeks and motion started. The motion at the elbow gradually increased.

The X-ray taken three weeks after operation showed the fragment to be in perfect position. That taken 10 weeks after operation showed that the capitellum had rotated outward a little.

Dr. Hitzrot remarked upon the difficulty of determining the source of fragments split from the capitellum, especially in fractures of the head of the radius. Several years ago he presented before this society a young woman who had a fracture of the head of the radius. From the X-ray one could not determine that there was any injury to the capitellum, but at the operation there was found a fragment broken off from the capitellum which had become engaged in the fracture line in the head of the radius.

FRACTURES OF THE NECK OF THE SCAPULA

Dr. James Morley Hitzrot read a paper with the above title, for which see page 215.

DR. ARPAD G. GERSTER recalled a case observed by him as long ago as in October, 1872. He fixed the date because it was a few weeks after he had entered upon his service as a military surgeon in Vienna.

The accident that led to this injury occurred in the School of Equitation which was not far from the barracks in which he was on duty and had quarters.

An officer was thrown by a bucking remount and landed on his shoulder. He was a very muscular and rather heavy young fellow. The slightest passive motion excited a tremendous muscular contraction around the shoulder and howls of pain. As crepitation was plainly felt, a fracture of the humerus was first thought of, but on rotation the head of the humerus could be distinctly felt moving with the shaft. Then, looking at the patient from behind it was seen that the injured elbow was much lower down than its uninjured mate. This was most noticeable when the musculature of the shoulder and the arm was relaxed. There was present also a deformity or a subcutaneous defect visible at the normal site of the acromion, as compared with its mate; that is, a depression of the left shoulder. Careful manipulation and collation of all the facts demonstrated that the acromion, the coracoid process, the glenoid fossa and humerus were down together. Evidently there was a fracture of the neck of the scapula. In those days there was no X-ray. Diagnosis was not then as easily controlled as it is to-day.

In this case the treatment consisted in the application of a Velpeau bandage. As soon as that was applied, the patient's pain was much relieved and he became comparatively comfortable, especially after a morphine injection.

Billroth, called in consultation, examined the patient and confirmed the diagnosis.

The patient got well, and the function of his shoulder-joint was almost entirely restored.

ACUTE OPERATIVE DILATATION OF THE STOMACH

DR. BURTON J. LEE reported the case, for which see page 421.

DR. JOHN ROGERS said that in a report of a similar case published in the *Journal of the American Medical Association* about a year ago, it was stated that while the stomach was exposed in the midline above the umbilicus, the surgeon saw the stomach distend; he enlarged the wound and followed the stomach into the pelvis, and noticed stomach distended with fluid. He washed the stomach out with the belly open and saw the stomach gradually contract and refill, and the patient eventually recovered.

Dr. Rogers had always felt that ether had something to do with dilatation of the stomach. A year ago he operated upon an inguinal hernia under novocaine-adrenalin. It was a very simple case in a man of about fifty. He died of a dilatation of the stomach in about four days, verified by autopsy, and at that time the stomach was very much distended, with the small intestine also distended with fluid equally with the stomach, a brownish fluid which is quite characteristic of these cases.

There are several cases in literature in which a gastro-enterostomy has been done for acute dilatation of the stomach without the least benefit, and it cannot be said that anybody knows anything about the causation of the disease. The appearance strongly suggests something to do with osmosis in which there is a chemical disturbance in the blood. By exosmosis the fluid is poured out into the stomach and intestine, and there is such a vast amount of fluid that it is possible that they die of water starvation or of a concentration of some inorganic salt. Mechanical obstruction from the mesentery cannot, in his opinion, result in death.

Dr. Gerster said that in the absence of the pathologist's opinion regarding the actual cause of death, the forming of a theory is admissible.

The postmorten first demonstrated a very small heart and very small arteries. Now, then, that is a well-known cause of death after traumatism, but especially apt to occur after operations under anæsthesia. During the last year of his service at Mt. Sinai Hospital, he lost a patient, a young woman suffering from a small, free and stenosing cancer of the pylorus, from this combination of factors. A rapid and smooth resection was done followed by gastro-enterostomy. The whole operation did not take more than forty minutes and very little ether was used. Without premonition, the patient collapsed about thirty hours after the operation and died in syncope. Nothing could bring her back to life. Post-mortem inspection demonstrated the absence of hemorrhage or any other demonstrable complication. The heart and arteries were the size of those of a child of nine years.

Now, then, in Dr. Lee's case, there was hypoplasia and a rather prolonged operation, lasting an hour and thirty minutes. By this a great task was laid on that small heart and those small arteries. Second, there was found œdema of the lungs. These two facts taken together, with the anæsthesia, are sufficient to account for the death. He did not believe that the dilatation of the stomach alone, whether acute or chronic, could account for the death. Acute dilatation is of course a

grave factor interfering with the circulation, and may precipitate fatal syncope in the presence of cardiac insufficiency. Distention of the stomach would embarrass the action of lungs and heart and may thus bring on death. He would be inclined to accept these facts as an adequate cause of death: long anæsthesia, operative traumatism, a small and weak heart, small arteries; finally œdema of the lungs, perhaps due to insufficiency of the heart.

DR. ALEXIS V. MOSCHCOWITZ said that about seven years ago he operated for a bilateral inguinal hernia on a man under ether anæsthesia; three or four days after the operation, he developed an acute dilatation of the stomach and for two or three days afterwards the patient was in such a wretched condition that he feared almost at any moment to see the patient die. He, however, recovered.

To his chagrin, due no doubt to the vomiting and frequent washing out of the stomach, he had noticed the moment the patient got up that he had bilateral recurrence of his hernia. He disappeared for six or seven years. He then came to him again, and he operated upon his bilateral recurrent hernia one week ago yesterday. He persuaded the man, because of his bad experience with acute dilatation of the stomach, to have his bilateral hernia operated upon with local anæsthesia. The first day passed off very well. The second, third and fourth and fifth days the man suffered again from symptoms of an acute dilatation of the stomach, in spite of the local anæsthesia. He is all right now.

He also called attention to a specimen presented by him a number of years ago at one of the meetings of this society, in which there was an acute dilatation of the stomach. The specimen was removed very carefully. It was seen that the dilatation of the stomach and duodenum stopped short just where the superior mesenteric artery crosses the duodenum. Of course, the real reason for the acute dilatation of the stomach is not known. There are several theories, but a large number of observers still cling to the mechanical theory, others cling to the nervous theory of acute dilatation of the stomach, and there are still other theories. Which one is right is not known, but the specimen showed proved in that case at least, that the mechanical theory of acute dilatation of the stomach was correct.

POST-OPERATIVE INTESTINAL OBSTRUCTION

Stated Meeting, held January 12, 1916

The President, Dr. Charles N. Dowd, in the Chair

LATE POST-OPERATIVE INTESTINAL OBSTRUCTION

Dr. Seth M. Milliken presented a woman who had been operated upon for some pelvic condition in 1910. In April, 1914, she began to have pain in the abdomen and vomited. The vomiting continued without fever and no bowel movement after the onset. Enemata returned clear.

After three days she was admitted to Roosevelt Hospital with a pulse of 96 and a temperature of 94. When the abdomen was opened its lower portion looked as if it had been filled with cement. The small intestine was quite distended in the upper part of the abdomen, but the coils could be seen lower down perfectly flat. The intestine was traced down until a small band about the thickness of a piece of telegraph wire was seen on top of the mass of material which filled the pelvis. That was divided and the intestine lifted, showing a deep groove in it. It was found that the contents passed through, however, and the color returned. An attempt was then made to free some of the other intestines in the pelvis; the adhesions were stripped up for perhaps six or seven feet; no bleeding was encountered until the region of the uterus was approached. It never was seen and further interference was desisted from on account of the very dense adhesions. About a bottle full of melted vaseline was poured in and swashed around with the idea that it might keep adhesions from reforming. The wound was closed and the patient was in fairly good condition when she returned to bed. Her recovery was uneventful.

EXTREME EMACIATION FROM POST-OPERATIVE INTESTINAL OBSTRUCTION

Dr. Milliken also presented a woman, aged thirty-two years, whom he first saw on June 4, 1915, in the Medical Ward of Lincoln Hospital. The following history was given him:

> Admitted on May 11, at which time she had been sick for six weeks, the first two weeks with a feeling of general malaise, the last four weeks with continual vomiting, and loss of flesh and strength. She complained of a good deal of abdominal and precordial pain, and vomited frequently, vomiting several times a day since in the hospital. Repeated attempts to take X-rays of her

stomach had been unsuccessful, because the barium was immediately vomited.

On May 25, rectal feedings had been instituted, while she was still allowed to take fluids by mouth; the vomiting persisted.

When seen by Dr. Milliken the woman was terribly emaciated, very feeble and irritable mentally, complaining of pain, and annoyed by examination. There was no sign of a mass in the stomach. There was a low median scar, the result of a complete hysterectomy for fibroma, with removal of both tubes and both ovaries and the appendix, done at the Lebanon Hospital, in July, 1914. After this she had improved for some time, but the vomiting, which became severe early in January, 1913, and was absent after operation, had come back early in February, 1915, and had persisted ever since.

Operation (June 7, 1915).—Incision through left rectus. One per cent. novocaine with 1/10,000 adrenalin local infiltration. Incision about three and a half inches long exposed a small, firm stomach, and all the intestines completely collapsed, the large intestine being about the size of an index finger, and the small collapsed to the size of a baby ribbon. The great omentum, which was a mere film, was adherent to the anterior abdominal wall scar below, but caused no band.

Stomach showed only a small white scar on the upper anterior surface of the pylorus. The duodenum was also collapsed. The pyloric opening felt smaller than a cigarette end. Pagenstecher guy sutures were inserted above, below and on each side of the scar, which was then excised transversely, and the wound united by tying the lateral sutures, using the upper and lower as tractors. The wound in the stomach wall was closed with two layers of Pagenstecher, enlarging the pylorus so that a thumb easily penetrated. The wound was closed in layers, and skin united with figure-of-eight silkworm-gut sutures. Time of operation was 45 minutes. Patient's condition no worse.

The stomach was washed out on the table, and four ounces of tap water left in. She returned to the ward with a pulse of 160, respiration of 24, temperature 99.4.

The pathologist's report on the specimen removed was that it presented no evidences of malignancy.

Fluid diet was forced immediately after the operation, and a good deal was retained, but for the first three days the patient vomited frequently. On June 11, third day post-operative, the patient retained all her nourishment, and the enema returned slightly discolored. She improved wonderfully for two weeks, the abdomen filling out, though the gain in weight was not marked. The bowels moved very slightly, without enema. The sutures

FIG. 1.—Emaciation from post-operative intestinal obstruction; condition immediately before operation for relief. Weight fifty pounds.

FIG. 2.—Condition one hundred days after final operation. Gain in weight fifty-nine pounds.

were removed on June 21, the wound entirely healed by primary union. On June 24, sixteen days post-operative, the patient vomited a large amount of dark brown, frothy, undigested liquid, and continued to vomit on the 25th and thereafter until the 29th, when her condition had become grave, and the vomitus was distinctly fecal in character. She had apparently lost all the weight that she had regained, and was in desperate condition. She was so thin that the pylorus could be distinctly felt through the skin as a hard mass.

The abdomen was reopened by an incision along right rectus, from costal arch to about two inches below umbilicus. The incision was subsequently extended about two inches further. When the peritoneum was opened, the stomach was found distended with fluid. The pylorus was perfectly healed, no adhesions, scar soft. The thumb could easily be passed through the pylorus, and the stomach contents were easily compressed into the duodenum. As no obstruction apparently existed there, and as the obstruction had evidently been intestinal from the fecal vomiting, the small intestine was examined, beginning at the top, and rapidly traced all the way to the lower ileum, where a slight distention of the previously collapsed gut attracted attention. About five inches from the ileocæcal junction, a sharp, double-barrelled-shot-gun kink was found, adherent to the right wall of the pelvis. The kink was on the opposite side from the mesentery, and the adjacent surfaces of the gun-barrel were adherent for about one and one-half inches. This was separated with some difficulty, and the raw surface covered with a small piece from the omentum.

The patient was returned to the ward in fair condition, having stood the operation remarkably well. She was given nutrient enemas. She vomited once about two o'clock the next morning, and that afternoon the stomach was washed out, and only a small quantity of yellowish fluid obtained. At the suggestion of Dr. Anderson, my adjunct, two ounces of Russian oil was left in the stomach to encourage peristalsis, and fluid diet begun two hours later. The patient then made an uninterrupted convalescence, retaining all nourishment, and gaining marvellously each day.

On June 28, after the vomiting had commenced, and her condition had begun to deteriorate, she was weighed in her nightgown, and weighed exactly 50 pounds. At the time of operation on June 30, she had lost more than she had previously gained, and her astounding emaciation is well shown by careful study of the very poor photograph (Fig. 1). I believe at the time of the operation she did not weigh over 45 pounds. On July 21, three weeks after the operation, she weighed 60 pounds. On August 13 she weighed 70 pounds, and was gaining somewhat in strength. On the 19th

she weighed 77 pounds, and on September 1, 84 pounds. On September 24, eighty-six days after her second operation, she weighed 100 pounds, and could walk several steps with support. The general appearance was very satisfactory, and the static œdema in her legs, which had been very marked when she first got up, was beginning to diminish. On October 11 she was transferred to St. Andrew's Convalescent Hospital, where she gained very rapidly, and on November 13 she weighed 120 pounds, with her clothes, and was apparently in normal health, eating regularly, and rather forcing her diet. Her bowels are kept regular by 10 grs. of extract of cascara each night. Since then, by graduated exercises, her strength has improved, so that she can now squat very slightly, but if she attempts to go low she losses her power and falls. On December 20 she was walking quite freely, and weighed, with her clothes, 124½ pounds. Since January 8 she has gone out of doors, and is feeling perfectly well. She has cut out the extra feedings, and her weight at this time is 121½ pounds, in her ordinary clothes.

A history obtained late in July, when she seemed to be getting well, goes back to seventeen years of indigestion, with pain after eating, relieved by taking some powder on the point of a knife, and if obtained before operation, would have indicated gastric ulcer. However, her mental condition was also one of starvation, and it was probably impossible to get her to give such a history.

INCOMPLETE INTESTINAL OBSTRUCTION

Dr. Willy Meyer presented a woman, aged forty-one years, who had been operated on in July, 1915, for hernia, in one of the New York hospitals, and for appendectomy, cholecystectomy and gastro-enterostomy, on November 10, 1915. She made an immediate uninterrupted recovery from these procedures until the twelfth day after operation, when she suddenly complained of severe pain in left inguinal region; intestinal stiffening could be seen and felt, followed by loud gurgling sound. This repeated itself during the following days with attacks of vomiting. After the persistence of these symptoms for a week, without relief, a second laparotomy was done, which showed a band starting in the left lumbar region and passing across the intestines to the omentum. It distinctly compressed one coil, without, however having produced a pressure necrosis. This band was divided, and a number of other adhesions between omentum and intestines separated. Evidently an omental hernia had been present, and the handling of same had produced the condition described. On examining the small intestine, it was found that not far from the point of compression, firm

adhesions had transformed one coil into a clover-leaf-shaped stricture. Separation of the bands did not seem advisable; therefore entero-enterostomy. The patient made a perfect recovery.

The speaker does not remember a case where, after a simple herniotomy, an intestinal band had formed, producing incomplete obstruction.

SIMULTANEOUS RESECTION OF STOMACH AND TRANSVERSE COLON

Dr. Meyer presented also a man, thirty years of age, who had been sick for over five years with stomach trouble. X-rays pointed to a mass, 4 inches from the pylorus, on the major curvature of the stomach, representing either a tumor, or a large, projecting ulcer. The patient was greatly reduced. Operation, November 19, revealed a large mass at the site mentioned which could still be excised. While proceeding with resection, it was seen that the posterior wall of the stomach was firmly adherent to the anterior leaf of the transverse colon. Separation was impossible. Therefore, simultaneous resection of transverse colon, which was done in the typical way; both ends of stomach as well as intestine closed. The splenic flexure was much adherent, evidently in consequence of the old ulceration in the neighborhood, and could not be moved forward to any extent. Mobilization would have been necessary in order to use needle and thread. Stump of stomach also was small. Therefore, as an emergency, Murphy's button was used for both places. A projecting mass on the posterior side of the abdominal wall proved to be a broken down, cheesy retroperitoneal gland, which was also removed.

The transverse incision which again had been used gave splendid access.

The patient made a quick recovery, the buttons passing 12 and 15 days after the operation. The specimen presented a large, transversely placed ulceration, surrounding the stomach from the side of the greater curvature for about two-thirds, with overhanging borders. Examination showed malignancy.

Dr. William Darrach said that two months ago a patient came into the Presbyterian Hospital with a history that six hours previously she had been seized with a sudden severe cramp-like pain in her lower right abdomen. This pain continued in colicky attacks and remained in this one position. At that time, she had no other symptoms except

this acute, severe, colicky pain. She had no temperature, no increase in pulse; no leucocytosis and no rigidity. She gave a history of having her appendix removed eight years before. Since then there had been no further symptoms until this present attack. When the abdomen was opened there was found a band reaching from the sigmoid across to the site of the old appendix, of about the thickness of No. 6 Fr. sound. Underneath this was a coil of small intestine which was distended and moderately congested. It was removed, and a second coil was found to lie beneath the first. That also was removed, and then the band could be gotten at and was cut away from the sigmoid and also from its appendix attachment. The attachment at the old site was just at the angle between the terminal ileum and the cæcum, and was apparently due to the fact that in cutting the mesentery at the previous operation, the bare area had been left instead of being covered over.

This was the earliest acute obstruction he had seen. She was operated on eight hours after her original attack and, because of the early diagnosis, she made a very simple and uninterrupted recovery.

POST-OPERATIVE INTESTINAL OBSTRUCTION

Dr. Charles L. Gibson read a paper with the above title, for which see page 442.

Dr. Darrach remarked that intestinal obstruction is less frequently seen to-day than formerly, and he thought one reason for that was because the peritoneum is respected much more than it was ten years ago. When fluid is removed by a suction apparatus, such as Pool and Kenyon's, far less harm is done and the reaction to the injury of the operation is far less than when collections of fluid are mopped out of the peritoneum. Adhesions and consequent obstruction are much more likely to follow mopping than when fluid is either sucked out or allowed to remain behind. Frequently one sees perforated gastric ulcers where a tremendous amount of soiling takes place and yet no violent peritonitis and no bad adhesions result. Whereas, if that fluid is mopped out with violent sponging, the injury to the peritoneum and adhesions resulting in those areas will much more likely be followed by obstruction than if the fluid is left alone.

Dr. Howard D. Collins said that a week ago he operated upon a patient for a small uterine fibroid and also for adhesions about the colon. Forty-eight hours later there was a very marked ileus. For the first time he had used pituitrin for ileus in this case. It worked extremely well. There was a response in about a minute and a half, but absolute paralysis after it. He repeated the dose in an hour and then another

dose in two hours. Each time gave a marked discharge of gas, but the intestine remained paralyzed. On the following day he reopened through the peritoneum to take a look. The intestine looked perfectly normal and not markedly distended. The patient received doses of pituitrin ranging anywhere from every six to every four hours, from the third to the eighth day, when she died. He couldn't get anything through, except with the use of pituitrin, and then there would always be a response, but the promptitude was steadily decreasing until it took almost an hour before there was any response.

Dr. N. W. Green related the details of a case at the City Hospital in the services of Dr. Collins and himself, upon which he operated about a year ago, following some pelvic operation at another hospital. At that time she gave symptoms of chronic intestinal obstruction, chiefly of the large intestine. Upon opening the abdomen there was found a mass of adhesions over the large intestine and in the region about the umbilicus. It was impossible to relieve all the adhesions, and as she was suffering from a dilated cæcum, showing that the obstruction was in the large intestine, he did what seemed to be the most feasible thing at that time, that was a cæcosigmoidostomy and not an ileosigmoidostomy. She went very well for a few weeks. Then after that she began to complain again of considerable pain in her abdomen. To-night Dr. Collins had informed him she ballooned up again, so that he was compelled to reopen the abdomen. Instead of closing off the pelvis, which he had neglected to do on account of the haste required at the time of the previous operation, a loop of small intestine had apparently slipped down behind this cæcosigmoidostomy and become caught there; which produced the later intestinal obstruction.

Dr. H. B. Delatour said that his experience coincided with that of Dr. Gibson in that the majority of the cases of intestinal obstruction are post-operative. In making a diagnosis of intestinal obstruction, when it is complete, or nearly complete, one can receive considerable aid from the leucocyte count. In the cases in which obstruction has been complete the count has usually been above 20,000. In the immediate post-operative cases one usually finds a considerable length of intestine adherent, and in operating it is most imperative not to cease until one is perfectly satisfied that all points of adhesion have been separated, otherwise there will be a recurrence and persistence of the symptoms, and the operation will have been of no avail. It had been a matter of surprise to him to see the amount of separation one may do and the extent of raw surfaces which one has frequently to leave behind, and this without a recurrence of the obstruction. In such cases where two or three feet of intestine have been separated, there will be insufficient omentum or

other material to cover in all the raw surfaces. In these cases adhesions most likely take place, but fortunately are formed in such a way that no angulation is produced. The use of olive oil and other substances introduced in the abdominal cavity before closing the wound, to prevent adhesion, does not appear to be of much value.

In addition to the cases of complete obstruction such as Dr. Gibson has particularly referred to, there are many cases of post-operative adhesion and bands. Many of these patients are passed from one physician to another as neurasthenics, as they are constantly complaining of vague abdominal pains and, on a physical examination, nothing can be discovered. In a few cases the X-ray will show evidence of partial obstruction, but in most of them there are no pathological findings. He had operated many of these cases and found bands of adhesions which had at various points produced incomplete obstruction of some portion of the intestinal tract. In all patients who have had previous operation it is wise to bear in mind the probability of this form of adhesion and recommend re-operation.

Dr. Woolsey called attention to a paper by himself in 1910 on a similar subject, taking fifty cases that occurred in the Presbyterian Hospital in the previous five years. It was noticeable then, and it is still more noticeable now, that the great majority are rather late cases. Formerly the majority of cases of post-operative obstruction were early cases that were due to sepsis. We are able now to handle these cases more successfully so that they do not result in obstruction. The pituitrin that Dr. Gibson has spoken of is one of the means that we have of prevention. In the cases he reported he used eserine salicylate, and he had had excellent results with it. Pituitrin is an excellent remedy, but he doubted that its results had been much if any better. When hormonol was being advertised, the advertisements spoke of the exceedingly spasmodic or spastic contraction which was produced by eserine instead of a normal physiological peristalsis. He had seen some remarkable results following the use of it. Pituitrin or eserine is especially useful in the cases that are just bordering on obstruction, which are due to atony from distention, as much as anything, and which if allowed to go on are going to result in obstruction of the bowels.

It is rather remarkable what cases are followed by obstruction. Some of the worst cases of adhesions are not followed by obstruction, and, *vice versa,* some of the milder cases are. He operated on a patient from whom the appendix was removed in the course of another aseptic operation. Healing was perfect. Five years later she was operated on for intestinal obstruction. A band had strangulated a loop of the small intestine.

He had seen another case 15 years after an operation by Dr. Keen. A gangrenous loop of ileum was successfully resected. Obstruction seems not to affect most of the cases with very numerous adhesions and which we would think might result in intestinal obstruction. Perhaps it is due to the abnormal position of the intestines at the time adhesions take place, rather than to the number of adhesions.

Dr. L. W. Hotchkiss called attention to the paper presented by himself several years ago on this same subject, in which he confined attention entirely to the post-operative obstruction following operations for appendicitis. McBurney showed us several years ago, or at least he said, that secondary abscesses with obstruction were largely due to the character of the peritoneal infection. We all recognize, of course, the fibrinoplastic form of peritonitis which we see from time to time and in which we may have these obstructions from adhesions to wall of secondary abscesses and which the drainage is apparently ineffectual to prevent. He said he remembered that McBurney reported a case here, and he himself has had an experience of the same sort, wherein an intestinal loop which had been originally adherent on the right side pulled away and a secondary abscess formed on the left side with obstruction at that point.

As Dr. Gibson has found, he had lately also run against several obstructions due to bands and post-operative herniæ. Within the last few weeks he had had several experiences with these cases. In one case a large hernia had followed a comparatively simple abdominal operation. This was followed by strangulation in the hernia several years later, with gangrene of the gut and a fatal ending.

Last fall he had a case in which intestinal obstruction followed twenty years after the original operation. The doctor thought it was a typical biliary colic. He said he would make the same diagnosis again in a similar case. The woman had such terrific pain. He found at operation 4 days later ten feet of small intestine caught in a band which apparently had resulted from an operation twenty years before. The intestine was entirely gangrenous and the patient succumbed on the fourth day after the operation.

A case of that sort disturbs one a good deal. It is not clear what we are going to do about it. Dr. Gibson has not presented any corrective. These cases undoubtedly occur, and it is up to the men who see the cases and make the diagnosis (and a great many of these cases, as Dr. Gibson has remarked, are not comprehended at all). Those of us surgeons who watch these cases which are partially obstructed understand that when complete obstruction sets in immediately there is

a very definite change in the patient's pulse and expression and we waste no further time. After all, it is a question of early diagnosis.

DR. MILLIKEN had seen a case where a man had been stabbed, wounding the concavity of the splenic flexure, with a good deal of hemorrhage. The exploratory was made through the left rectus incision and then the transverse incision was carried around from about the middle of the incision to the tip of the twelfth rib. In that case he did not catch the rectus muscle above and below, as Dr. Meyer recommends, and he regretted it afterward, because apparently a small hæmatoma occurred there with an extensive infection. The upper half of his rectus and the upper half of the oblique muscle sloughed out. No hernia resulted. He has a tissue paper wall which seems to flap in and out, but there is no herniation. It is a perfectly good abdominal wall without any muscle in upper left quadrant.

DR. WM. C. LUSK endorsed the use of pituitrin in cases of post-operative ileus. In two such cases the use of pituitrin was followed by what seemed to him very remarkable results. In the first case in which he ever used it, he had tried numerous enemas without success and had about given up in despair when the house surgeon said to him, "Why don't you give a dose of pituitrin?" He said, "You can give the patient anything that offers any chance of causing the bowels to move." He injected the pituitrin and within half an hour the bowels had moved copiously. He went home feeling that in pituitrin there had been added to surgery a great adjuvant in the treatment of this complication. The difficulties and the result in the second case were similar to those in the first. He had seen pituitrin move the bowels in septic peritonitis.

DR. DOWD said that it is manifest that all unnecessary traumatism should be avoided. But men differ in their conception of what constitutes unnecessary traumatism. Small drains will often be as efficient as large ones. Simple drainage of abscesses is often more efficient than extended efforts to clear their walls. The intestines may usually be left undisturbed if the primary focus of infection is removed. We are continually learning that manipulations are unnecessary which were formerly considered essential. In our teaching and in our practice it is surely wise to emphasize these facts if we would avoid these troublesome adhesions.

DR. ALEXIS V. MOSCHCOWITZ said that almost everybody must have seen cases of bands and adhesions formed after the simplest operation, and that is not at all surprising. However, almost everybody must also have seen cases where one might expect very voluminous adhesions, and when these cases come to a secondary operation they have entirely

disappeared. He believed the crux of the entire matter is the question of productive inflammation. Unfortunately, no one knows what causes productive inflammation, and more unfortunately still, no one knows how to prevent a productive inflammation.

CARCINOMA OF THE RECTUM

DR. WILLIAM DARRACH presented the following case:

A woman, fifty-six years of age, who came to the Presbyterian Hospital, April 26, 1915. Physical examination revealed a cauliflower-like mass to be felt and seen about three inches within the anal margin. The rectum was freely movable and the posterior vaginal wall did not seem to be involved.

On April 28, 1915, with the patient in the Trendelenburg position, a 5-inch, left rectus incision was made and deepened through the peritoneum. The mass could be felt just above the levator ani muscles. No glands could be felt either near the growth or higher along the course of the vessels. The liver seemed normal. The sigmoid was long and with a free mesentery. The peritoneum of the latter was cut and stripped back and the vessels tied off and cut. The bowel was crushed, cut with the cautery and both ends invaginated. The peritoneum was then cut on either side of the mesentery of the distal portion of the gut, near its posterior attachment, and stripped back on either side almost to the brim of the pelvis. The underlying fat and contained structures were stripped away from the pelvic walls down to the pelvic floor and the bowel separated from the uterus and vaginal wall. The mass was then dropped into the pelvis, a towel placed over the wound, and the patient put in the lithotomy position. The anus was surrounded with a circular incision and the anal opening closed with silk. The incision was carried back to the coccyx and deepened to the levator ani muscles. The latter were cut through about an inch from their rectal attachment and the whole mass pulled out from below. Bleeding points were carefully ligated and two large strips of gauze inserted up to the hollow of the sacrum. The wound was closed in front and behind these strips and the patient again put in the Trendelenburg position. The peritoneal flaps were closed with continuous catgut and the proximal end of the bowel pulled out through an intermuscular incision a little to the inner side of the anterior superior spine. The skin opening was a little above and outside the muscular opening. The edges of the bowel were sewn to the skin edges. The rectus incision was then closed tight in layers.

The operation lasted two hours. After the operation she received 600 c.c. of salt solution intravenously and also had about

a quart of hot saline poured into her peritoneal cavity just before it was closed. There was no nausea or vomiting afterward and she was put up in a Gatch bed after a few hours. Her temperature was between 98°–100° most of the time during her convalescence, reaching 101° once, on the sixth day. Her highest pulse rate was 84. The perineal gauze was removed on the second day after operation and there was a purulent discharge from that wound for several weeks. At the end of the second week the posterior vaginal wall sloughed over a small area and this left a sinus communicating with the perineal wound which has persisted intermittently ever since. The colostomy was opened on the third day and has functionated very well since. She has one movement a day following a small enema with no leakage between times. Gas escapes very rarely. Part of the day she wears a cup over it attached to a narrow webbing band. Six weeks ago the skin around this opening had contracted down so that it would not admit a finger. Under novocaine it was enlarged at both ends. At present there is no sign of any recurrence and she is enjoying the best of health.

FRACTURE OF THE UPPER EXTREMITY OF THE HUMERUS TREATED BY THE ABDUCTION METHOD

DR. ROYAL WHITMAN presented a girl nine years of age to illustrate a perfect functional result after fracture of the upper extremity of the humerus just below the epiphysial junction, treated by the abduction method. The patient had been admitted to the Hospital for the Ruptured and Crippled last August, within a few days of the injury, because attempts at reposition of the fragments had been unsuccessful (Fig. 3).

In cases of this class, of which this was a typical example, the shaft of the humerus is usually displaced upward in front of the head. Reduction by ordinary means is not often successful, and in many instances the head of the bone is subsequently removed in order to restore motion. The injury was therefore of more importance in childhood than in adult life, because of its effect upon the development of the arm.

The method of reduction was as follows: The arm was raised almost directly upward, thus moving the extremity of the shaft downward, and at the same time rotating the scapula, making the joint prominent laterally. By traction on the arm, and by leverage on the acromion the fragments were disengaged, and the head replaced by direct manipulation (Fig. 4).

A shoulder spica was then applied with the arm in the elevated position, with such rotation and forward inclination as most perfectly adjusted the fragments.

FIG. 3.—Radiograph taken through the dressing on admission, showing the characteristic displacement of the shaft forward and upward, the head lying behind and below.

FIG. 4.—Radiograph taken through the plaster splint after reduction. The arm is raised to an angle of about 130 degrees (40 degrees below the limit of abduction), the forward inclination being about the same with the forearm flexed over the head. The accessibility of the head of the humerus caused by the attitude and by the rotation of the scapula is evident.

In this instance the forearm was flexed over the forehead as if to protect it. He had called the procedure the abduction method because it was somewhat similar to that for fracture of the neck of the femur. He thought this the only practicable method of reducing displacements of this character, and of fixing the fragments subsequently, since this was assured by pressure and by the force of gravity, as well as by the splint.

He had first employed the treatment in 1902 (ANNALS OF SURGERY, May, 1908), and always with success since that time, and although all the patients were children it should be equally efficacious in the treatment of adults if applied soon after the injury.

DR. CHAS. N. DOWD said that he had treated two such cases in adults this fall. In both instances the fragments had gone under the coracoid. Under ether, even with the aid of incisions, it was impossible to get the fragments back. One of them had been displaced for a long time, and the fragment was very firmly imbedded. In the other case the operation was done three days after the injury, and it was impossible to get the fragment back, even when two incisions were made, so he was sure that there are a great many more difficulties in muscular adults than there are in youngsters. In both of these cases the fragments were removed.

ARTHROPLASTY FOR ANKYLOSIS AT THE ELBOW-JOINT

DR. WHITMAN presented a girl nineteen years of age, on whom he had performed arthroplasty for ankylosis at the elbow.

He said that the history of the case began with the treatment of the tuberculous disease in early childhood, which had resulted in practical ankylosis. Four years before, he had attempted to restore motion by arthroplasty, interposing flaps from the neighborhood of the joint, but after a comparatively short period motion was again lost.

In August, 1914, a second operation was performed, at which it was found that the original fibrous ankylosis had been transformed by the previous operation to solid bone. A new joint was fashioned in the usual manner, permitting under traction a separation of half an inch. The surfaces were then covered by a flap of fascia from the thigh. The result was very satisfactory in restoring function. There was perfect flexion, extension to 165°, and a sufficient range of pronation and supination without laxity of the articulation.

In cases of ankylosis following tuberculous disease in which the tissues about the joint were atrophied he thought that the free fascia transplantation was essential to success.

BOOK REVIEWS

BONE-GRAFT SURGERY. By FRED H. ALBEE, M.D. W. B. Saunders Co., 1915.

Ollier, Nélaton, Malgaigne, Velpeau, Esmarch, Dieffenbach, Volkmann, Mikulicz, Adams, Liston and Ogston—the pioneers of modern bone-surgery—perhaps little realized that they were laying the foundations for a surgery of bone that should transcend their fondest hopes. The antiseptic era, into which they lived, developed as its greatest achievement the possibility of implanting dead and inorganic material to take the place of missing bone. This was regarded as the wonder of the antiseptic art. Now comes the newer bone-surgery. Foreign substances, it is shown, are antagonistic to nature. Autogenous material harmonizes. Living bone may be transplanted into living bone, and a healthy growth continued with but little interruption of the normal processes. By introducing living autogenous bone into a bone-defect in such a manner that corresponding structures are made continuous—periosteum to periosteum, endosteum to endosteum, and marrow to marrow—results are secured which actually restore the normal physiologic conditions; with which prosthetic implantations, braces, fixation apparatus, and amputations are in no sense comparable.

The newer bone-surgery is revising the whole subject of amputations. The loss of a large part of the proximal bone, supporting a limb, is no longer a cause for sacrificing the whole member. The shaft of the femur, humerus, and phalanges may be restored by implantation of living bone, and amputations obviated. Indeed, this new bone-surgery, in conjunction with blood-vessel anastomosis and reconstruction, nerve suture and neuroplasty, tenoplasty, and skin and connective-tissue flap-construction, promises to make amputations of limbs a rare procedure in the realm of modern surgery.

Cellular life, it is now known, is independent of the life of the whole organism. The individual cells of the body do not die when the phenomena which are called death intervene. Bone tissue, as well as all of the other tissues, is still alive in the true biologic sense long after the somatic activities of respiration and circulation have ceased. Morfurgo has shown that the periosteum of a corpse can produce new bone one hundred and sixty-eight hours after the death of the individual. It is not true that transplanted bone acts only as a scaffolding for the growth of new bone from without. Grafts of living bone have life inherent in

them, and are capable of retaining their bony qualities and of developing more bone.

Dr. Albee has presented the fundamental principles of bone histology, growth, repair and degeneration. These newer conceptions are quite essential to the surgeon for a happy prosecution of his work. The technic of bone-grafting is made clear. The many ingenious devices which are employed for cutting grafts in the desired shapes, for making dowels, and for excavations for the reception of transplants are all presented.

Bone-grafting is well described in the treatment of tuberculous spondylitis. The author calls this Pott's disease, although in fact, so far as ownership is concerned, the disease belongs to the patient and not to Mr. Pott, and so far as the disease is concerned; Mr. Pott's grandfather possibly had it, and his father's family physician might have written a better description of it than he did. This same Percival Pott published a pamphlet on the anatomy of congenital hernia after he had visited the Hunters and had been shown their beautiful dissections of hernia; but the name of Hunter does not appear in his pamphlet. Now we find him riding down the avenue of time on the backs of the unfortunate victims of a very old and common disease. It is high time he is dismounted. The patient and the surgeon have enough to contend with without having Pott imposed upon them as a perpetual mortgage.

Dr. Albee presents the new treatment of spondylitis. Fixation is secured by the bone graft, applied to the spinous processes. It is indicated at all ages where pain or muscular spasm proclaim sinking in of the vertebral bodies. The earlier the operation is done, the better is the prognosis. It is especially indicated in the presence of increasing deformity, and complications such as psoas spasm, abscess, and paraplegia. The results are better than by any other method of treatment.

Bone-grafting is described for paralytic scoliosis, spina bifida, and sacro-iliac disease. In the treatment of fractures, metal plates, as recommended by Mr. Lane, are unqualifiedly condemned. It is conclusively shown that such foreign bodies cause osteoporosis and defeat the conditions they are supposed to help. Metal, in the form of plates or wire, is not to be advised for bone-fixation. Metal causes absorption of bone; bone-grafts cause a deposit of bone. The device for treating fractures of the surgical neck of the humerus is beautiful. The same is true of fracture of the olecranon. The wedge-shaped grafts, used to enlarge the bone-ends in old ununited fractures, are most effective.

The technic of treating fractures of the neck of the femur, patella, os calcis, lower jaw, and other bones is well presented. Osteoplastic

operations on the hip and knee are quite original. The range of application of bone-grafting in diseases of the joints is very great. Bone-grafting in the treatment of club-foot introduces the new principles which produce the most perfect operation yet devised. New bone is placed where bone is needed to remedy a defect which is characterized by absence of bone.

This book of Dr. Albee's is one of the most useful surgical publications that has appeared in these particularly unfruitful times.

JAMES P. WARBASSE.

AUTOPLASTIC BONE SURGERY. By CHARLES DAVISON, M.D., and FRANKLIN D. SMITH, M.D. Philadelphia: Lea & Febiger, 1916.

This book deals with the same subject as that of Dr. Albee, although the two titles are quite different. The first book is something less than bone-graft surgery, the second is something more than autoplastic bone surgery. Each deals with autoplastic bone-graft surgery, as their titles should so imply.

This work of Davison and Smith, one of whom is a surgeon and the other a pathologist, presents an illuminating résumé of bone physiology and pathology. Even the history of these subjects is not slighted. The earliest report of bone transplantation is found to date back to 1682. It is discovered in the work of A. Blasio, published in Amsterdam. Here is found a decree against Jobus Meekren: "*Chirurgicum ossis cranii fragmentum anferre jussit, sique, curatione alia adhibita excommunicationis vim effugit.*" Jobus Meekren had transplanted a piece of the skull of a dog into a defect in the skull of a soldier. At this time and place the Christian Church was so powerful that Jobus Meekren was forced to remove the implanted bone or suffer excommunication from the church, which no man who had his livelihood to earn could afford to suffer. This monumental piece of surgery was referred to as "an unchristian" method of treatment.

One of the striking facts which experience has brought out is that the wound of transplantation is no more likely to become infected than any other wound of bone. The transplant consists of living tissue, which has positive germ-resisting properties. When the transplant becomes infected it becomes exfoliated only in a small proportion of cases. The authors think very highly of the inlay-transplant method of Albee, used in fractures, which consists in sliding across the fracture a graft taken from the long fragment.

The influence of the X-ray upon diagnosis is seen in the reports of cases in which the surgeon dares not state that his examination shows a fracture. The following is the modern method of expression: "Exam-

ination *showed* a man with the *symptoms* of fracture of the upper end of the left humerus. A röntgenogram *revealed a fracture* through the anatomical neck of the humerus." Before the days of the X-ray it was the surgeon's examination that *revealed* the fracture; nor did the surgeon in those days hide behind the hypothetical implication of symptoms.

This book contains many pictures, showing upon prepared specimens of bone, the methods of making transplants. There are many pictures of fractures which show nothing more than the fracture. They imply that bone-grafting would remedy the defect, but in many of them other treatments would be equally effective. For fracture of the neck of the femur a peg made of the fibula is used, although it would seem that a tibial graft would answer as well; and there is no doubt but that the loss of the fibula weakens the leg of a working man. This book, like that of Albee, shows abundant proof of the deficiencies and harm of metal plates in the treatment of fractures.

The crest of the tibia is called the spine of the tibia, which is surely a very poor name for a crest. In the treatment of old, ununited fractures of the patella, all methods are given but the best, which is that described by Albee, making use of an hour-glass shaped transplant.

In this book is described the very effective method of Hibbs for securing bony union between the spinous processes for spondylitis. Albee does not mention it. The method of Halsted and that of Don for securing spinal ankylosis are described, although ignored by Albee. The operation for congenital dislocation of the hip seems like a better procedure than that described in Albee's book. The plastic operation shown for covering defects of the skull by means of a transplant from the scapula is beautiful. Both books show the very effective transplant method described by W. W. Carter, for the cure of nasal defects.

This book supplements that of Dr. Albee, and the book of Dr. Albee supplements this. The field of autoplastic bone-graft surgery is so large and is developing so rapidly that many books may yet be written before a redundant publication appears.

JAMES P. WARBASSE.

A MANUAL OF SURGERY FOR STUDENTS AND PHYSICIANS. By FRANCIS T. STEWART, M.D., Professor of Clinical Surgery, Jefferson Medical College. Fourth Edition, 774 pages, 580 illustrations. Philadelphia, Pa.: P. Blakiston's Son & Co., 1915.

That a fourth edition of this book has appeared means two things. There is a demand for the book, and the author is attempting to keep the statements contained in the book up to date, in such a treatise a most difficult task.

The book is a Manual which does not pretend to be exhaustive excepting in the number of subjects considered. It is a concise statement about many surgical diseases systematically arranged. It is carefully edited. Comment upon the subject matter is impossible in any brief review. The volume is a compendium or index of surgery. It will serve as a convenient and safe guide to the undergraduate student of surgery.

CHARLES SCUDDER.

STUDIES IN SURGICAL PATHOLOGICAL PHYSIOLOGY FROM THE LABORATORY OF RESEARCH OF NEW YORK UNIVERSITY. Volume I, 1915.

This little volume contains a series of papers which record work done in the laboratory of experimental surgery of the New York University. It represents, therefore, work which is peculiarly characteristic of the newer surgery of the present decade. As stated by Dr. John William Draper, by whom the papers have been edited, and who in the faculty of the University is the associate in charge of the Department of Experimental Surgery, these papers are the result of surgical investigations which have had to do, first with problems of functional diagnosis, and then have proceeded to the consideration of therapeutic progress as depended upon these, and lastly upon details of method and technic. The point of view from which the work of a laboratory of surgical research is to be considered is best presented in the paper by Drs. Stewart and Draper which was read before the American Hospital Association at San Francisco in June last. This paper is a plea for the further development and enlargement of experimental work in surgery and a demonstration of the importance of a surgical laboratory in hospital work. It is summed up in its concluding paragraph as follows: "Full recognition of graduate schools and a free hand to correlate surgical studies upon lower mammals with coördinate studies upon the highest mammal, man, in the surgical laboratories and in the hospital wards, will tend further to fuse medicine and surgery, improve the grade of students, diffuse knowledge, and ultimately serve to lighten the burden of fostering medical progress." The work which Dr. Draper and his associates have been endeavoring to do in their laboratories, the results of which are presented in this collection of papers, has the full sympathy and admiration of the ANNALS. It is a satisfaction to the writer to note how much of this work has already been brought to the attention of the medical profession through the pages of the ANNALS OF SURGERY. This book ought to be a stimulus to thoughtful surgeons everywhere for the future development of work along similar lines.

LEWIS S. PILCHER.

CORRESPONDENCE

THE ROLE OF ABDUCTION IN THE TREATMENT OF HIP FRACTURES AS COMPARED WITH ARTIFICIAL IMPACTION

To the Editor of the Annals of Surgery:

Dr. F. J. Cotton introduces his interesting paper, published in the March issue of the Annals of Surgery, with the very kindly and complimentary statement "that between Astley Cooper and Royal Whitman I know of nothing worth while save a paper by Newton Shaffer on work done about 1886." Further, "Whitman has done something real, contributing to real results along the lines Shaffer first laid down."

Shaffer's paper, to which he refers, describes the successful treatment of a case of ununited fracture of the neck of the femur by means of a Taylor traction hip brace supplemented by a surcingle for pressure on the trochanter.

The brace was applied with the limb at an angle of 45 degrees of flexion and 20 degrees of abduction, the object of the abduction being to oppose the constant pull of the traction brace to the contracted adductor muscles, and thus with the aid of direct pressure to assure the contact of the fragments.

It should be evident, however, that muscular resistance and shortening established by three months of non-union, as in Shaffer's case, are not present in recent injuries, and that the traction hip brace is simply a modification of traction treatment. If the hip brace were at hand, and if it could be applied and supervised by a Shaffer, it might be of practical value in recent cases, but hardly so under the ordinary conditions of practice.

"The lines laid down by Shaffer," *i.e.*, 20 degrees of abduction to utilize a supposititious adductor tension, and a plaster spica in place of the traction brace, which alone could make those lines effective, represented Cotton's conception of the abduction treatment when his book was published; a confusion that apparently still persists.

The genesis of the abduction method had no relation whatever to the Shaffer treatment. It was originally devised for the correction of the deformity of incomplete fracture in children, by utilizing the leverage of the limb, the tension of the capsule, and the fulcrum of the acetabular rim to restore the normal angle of the neck.

As applied to complete fracture, the displacement is first reduced by manual traction under anæsthesia. The limb is then drawn outward and fixed in complete abduction and complete extension by a plaster spica. The mechanism is dependent on the tension thus produced upon the capsule, which directs the fragments toward one another, forces a contact, and locks the parts by mutual pressure. In some instances, also, there is actual engagement of the outer fragment beneath the acetabular rim, or contact of the trochanter and the pelvis that still further assures security. Muscular tension, except in the sense that it is completely relaxed, has no part in the adjustment.

The abduction method in a comprehensive sense is the only effective means of applying surgical principles: namely, the immediate reduction of the deformity, whether complete, incomplete, or impacted, whether at the base or at the extremity of the neck, and securing fixation of the fragments for a time sufficient to permit union. These essentials are supplemented by adequate protection during the period of repair.

Dr. Cotton states "that fractures at the base of the neck (extracapsular) are going to unite anyhow, with good or bad treatment."

"Intracapsular fractures, if unimpacted, never unite by bone under routine treatment. Well impacted fractures do so unite." Consequently one should induce artificial impaction.

Dr. Cotton has made the statement elsewhere "that the majority of hip fractures are impacted." It follows, therefore, that bony union results in the majority of cases irrespective of the character of the treatment.

Assuming, for the sake of argument, that he is correct, then the disability that characterizes the majority of cases—a characteristic thoroughly established by every investigation of final results—is not due to non-union, but to unreduced deformity; consequently, the reduction of deformity is the essential preliminary to success.

In order to prepare for artificial impaction, displacement is reduced under anæsthesia, and after the "malleting," the limb is fixed in abduction by a plaster spica, and, judging from the illustration of the most successful case (Fig. 11), in full abduction. Now since abduction and artificial impaction are so combined, which of the two is of greater importance?

It can be easily demonstrated that deformity may be reduced, and that the fragments may be held in forced contact with one another by the proper application of the abduction method. What, therefore, is gained by malleting the trochanter "until something gives," which can only mean further injury to an already injured bone? Artificial im-

paction must be supplemented by the support of a plaster spica in abduction, and it may not even assure, by itself, permanent security, since according to Cotton " always in hip fracture there is considerable absorption " which should be most evident at the seat of greatest injury, the artificial impaction.

I conclude, therefore, that the great advantage of artificial impaction is the manipulation that precedes it and the fixation that follows it. If, therefore, impaction is the necessary incentive to reduction of deformity and adequate protection I should be willing to accept it on that account. Cotton, however, in his enthusiasm for artificial or incidental impaction, loses sight of the dependence of normal function upon normal form. In a previous paper he has stated that " it is a crime to disturb an impaction in fairly good position," and in this article he speaks of " deformity in adduction and eversion not great enough to warrant any interference." But since a certain range of abduction is essential to a normal gait, there can be no degree of adduction so slight as not to warrant correction, because it may be safely and easily accomplished, in the manner that I have so often described.

The abduction method, as an efficient and exact means of accomplishing a definite purpose, requires a certain technical facility in its application, and above all an understanding of the mechanical principles on which it is based. It is placed at an unnecessary disadvantage by the misconceptions of the writers of text-books and special treatises, who, lacking both understanding and practical experience, present interpretations in the place of reproductions of the author's descriptions, one of which may be found in the ANNALS OF SURGERY for October, 1914.

ROYAL WHITMAN.

New York, March 8, 1916.

REPAIR OF VESICOVAGINAL FISTULA.

ANNALS OF SURGERY:

Since the publication of Dr. Charles H. Mayo's paper, "Repair of Vesicovaginal Fistula," in the January issue of the ANNALS, in which he says: "I am personally indebted to the late Dr. Bernays for the principle of the operation, though I am unable to say whether it originated with him," he has learned that the operation was devised by Dr. R. F. Amyx, and first performed by him December 17, 1902. It was demonstrated to Dr. Bernays the following year."

MAUD H. MELLISH,
Mayo Clinic, Rochester, Minn.

February 12, 1916.

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ANNALS *of* SURGERY
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